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MANURING COCONUTS.

Readers of the TROPICAL AGRICULTURIST are referred to the article contained in the present number on the manuring of coconuts.

This is a subject which has received a considerable amount of attention during recent years and in this subject a good deal of interest has been shown in Ceylon.

The value of manuring coconuts is well known to coconut growers and various practices have been evolved through ages of experience. Accurate experimental data on the effect of different manures on coconut crops are however scanty and are not easy to secure except when considerable areas of palms can be dealt with and the proper duplication of plots made in order to make the probable error of experiment calculable. In Madras, the study of the coconut has been conducted on several experiment stations, but attention has been largely directed to the physiology of the tree and to cultural operations.

The writer of the present article has had considerable experience in dealing with the subject under review and he bases his observations upon experience gained in Ceylon. His article is therefore deserving of careful attention by all growers of coconuts.

In previous numbers of the TROPICAL AGRICULTURIST reference has been made to this subject and the good results which can be secured from manuring young palms has been brought to the attention of readers.

The problem of the proper manuring of old palms still requires final solution, but much information of value has been accumulated.

In Ceylon it is now general to make use of cattle manure, of tying cattle or buffalos around the palms and of all ashes which result from the burning of the fallen leaves, etc. The use of coir dust from fibre mills has increased in recent years and the value of burying husks has been demonstrated in some areas.

There are several estates which are using green manures and it is expected that this system will increase considerably during the next few years, especially on those estates where ploughing is becoming general.

The majority of the larger estates also make applications of artificial fertilizers. These are applied annually or more frequently every two years. These applications generally consist of mixtures and their constituents vary with the decision of the estate proprietor or superintendent, and with the cost of the different manures in Colombo. Some guide to the composition of these mixtures can be obtained from the results of the experiments on the Chilaw Trial Ground and of those carried out by the Colombo Commercial Company.

These experiments have, however, been conducted on only a small scale and therefore the results obtained so far must not be accepted as being finally conclusive. They can only serve as a guide and it is always advisable that estates should make their own experiments. Many have done so and have gained information of certain practical value.

The examination of the results of the various experiments carried out in Ceylon and a consideration of them, together with actual experience in connexion with estates, have formed the ground work on which the present article is based, and it is hoped that it will be helpful to those who desire to make a careful study of the subject.

It is not to be concluded that finality has been reached. Every estate must make experiments of its own if it desires precise information for its peculiar soil and climatic conditions. It is also expected that on the Central Coconut Experiment Station which is to be started in connexion with the Coconut Research Scheme, manurial experiments will be laid down in order to secure further information. The methods of application of manure is also another subject that requires investigation, for on this point in Ceylon there is still a considerable divergence of opinion.

TEA.

AN EXPERIMENT WITH TEA SEED IN MANURED SOILS.

FREDRICK LEWIS.

Six samples of soil from a Tea Estate, in a wet district, were selected in the following manner.

(A) "Top Soil" from Forest land, that had never been cleared.

(B) Soil from a Tea field that had been in cultivation for approximately 24 years.

(C) Soil from a very exhausted piece of Tea land, that had been under cultivation for approximately 28 years.

All these samples were carefully freed of fragments of stones, pebbles, or bits of wood, and were separately sifted, and divided as follows :

Two samples, ... A & A1, of soil "A"
Two samples, ... B & B1, of soil "B"
and Two samples, ... C & C1, of soil "C"

Each sample of soil was put into a wooden box, which was first carefully prepared by drilling drainage holes, and by placing over them some rough gravel and straw, so that there was no chance of the soil becoming water-logged, and at the same time care was taken to preserve an equal depth of porous strata in each box, and a corresponding depth of soil above it.

A useful manurial preparation was next made from a well mixed composition of :—

400 lb. Fish guano
100 lb. Fish manure
100 lb. Blood meal
70 lb. Algerian Phosphate
and 70 lb. of Muriate of Potash.

From this, four ounces of the mixture was added and well mixed with the soils above, which were then sorted out as follows :

Box A. Forest soil alone
,, A1. Forest soil with 4 oz. of mixture
,, B. Soil from 24 year land, simple
,, B1. do do with 4 oz. of mixture
,, C. Soil from 28 year land, simple
,, C1. do do with 4 oz. of mixture

Immediately afterwards I planted mixed Tea seeds in each box. The seed was from a well known estate, the present trees of which were from high jat Indian seed, planted in, or about, the year 1879.

The seeds were planted at a uniform depth of 3 inches from the surface, and were put in on the 28th April, 1923.

The boxes were placed on a stand out in the open, and when there was no rain, each box was watered by hand, to a volume as nearly as possible of ·50 of an inch, in terms of Rainfall.

By the 31st of May, there was no sign of Tea seed germination, but the rainfall for that month was below normal, though as stated above it was artificially compensated for. The shade temperature for the period was 80°F. max. and 52°F. min.

The boxes in which these soil samples were placed gave the following superficial areas.

(Unmanured)	Box	A.	=	121	sq. inches	=	$\frac{1}{51840}$	of an acre
(Manured)	,,	A1.	=	116	sq. ,,	=	$\frac{1}{54074}$	of an acre
(Unmanured)	,,	B.	=	108	sq. ,,	=	$\frac{1}{58080}$	of an acre
(Manured)	,,	B1	=	110¼	sq. ,,	=	$\frac{1}{56894}$	of an acre
(Unmanured)	,,	C.	=	108	sq. ,,	=	$\frac{1}{58080}$	of an acre
(Manured)	,,	C1.	=	102	sq. ,,	=	$\frac{1}{61496}$	of an acre

The object of recording the superficial area of each, is to show the result *per acre* of vegetable growth produced under the conditions applying to each, or in other words the following "crop" per acre.

On the 4th of June, or 37 days after planting of the Tea seeds put into each sample box, not one of the Tea plants showed above ground, but the weed growth was very remarkable. I pulled out all the weeds that could be removed without breaking their stems in the operation, giving the following result.

Box A gave 115 weeds; A1. gave 215; B. gave 0; B1. gave 2; C. gave 11; and C1. gave 4.

If these are multiplied by the superficial area of each box, we obtain the following results:

Sample	A	=	5,961,600	weeds per acre
,,	A1	=	11,625,910	do
,,	B	=	Nil	
,,	B1	=	113,788	do
,,	C	=	638,880	do
,,	C1	=	245,984	do

After removing the weeds, I divided them up into their natural orders, resulting as follows :

ORDER.	Sample A. Unmanured.	Sample A1. manured.	Sample B. Unmanured.	Sample B1 manured.	Sample C. Unmanured.	Sample C1. manured.
Compositæ ...	92	186	—	1	8	1
Geraniaceæ ...	3	5	—	—	—	—
Cruciferæ ...	1	1	—	—	—	—
Amarantaceæ ..	—	6	—	—	—	—
Araceæ ...	5	4	—	—	—	—
Cyperaceæ ...	3	2	—	—	3	—
Gramineæ ...	5	11	—	1	—	3
Commelinaceæ ...	1	—	—	—	—	—
Rutaceæ ...	1	—	—	—	—	—
Euphorbiaceæ ...	2	—	—	—	—	—
Unclassed ...	2	—	—	—	—	—
TOTALS ...	115	215	—	2	11	4

I had no means at my disposal sufficiently accurate for the purpose of determining the exact weight of weed thus collected and thereby to show that result to the acre, but the foregoing figures afford interesting data. It must also be borne in mind that these figures apply only to the first weeding, which, as will be seen, was confined only to those that could be conveniently collected.

The germination of the Tea seed was as follows :

On the 8th June, or 41 days after planting :—

Sample A. had 1 plant above ground
,, A1. had none
,, B. had 1 plant above ground
,, B1. had none
,, C. had 1 plant above ground
,, C1. had none

It will be observed that in none of the manured soils was there a single Tea plant above ground, but contrasted with the weed result, with the solitary exception of sample C, the manured samples indicated a much more marked germination than the unmanured.

By the 10th of July, or 73 days after the seed was planted, the following was the result in Tea plants :

Sample	A.	(unmanured)	8 Tea Plants
,,	A1.	(manured)	1 Tea Plant
,,	B.	(unmanured)	5 Tea Plants
,,	B1.	(manured)	10 Tea Plants
,,	C.	(unmanured)	7 Tea Plants
,,	C1.	(manured)	6 Tea Plants

The point to be observed here is that, while the manured Forest soil produced practically double the weed growth, it produced the lowest result in Tea seed germination or growth, while the maximum of Tea Plants appeared to respond to manure in a soil that had been cultivated with Tea for 24 years, and which, for reasons that are not apparent, produced only 2 weeds.

On the 30th June I pulled out all the remaining weeds that were too small to gather on the first occasion, and these I sorted into their natural orders, with the result that

Unmanured Sample A. had produced

20	Compositæ
3	Gramineæ
1	Araceæ
4	Geraniaceæ

Manured sample A1. had produced

50	Compositæ
1	Umbelliferæ
10	Araceæ

The remaining samples except for most minute examples, were weedless.

Adding the first and second weedings together, we still find that the weed result appears to point to a very rapid and extraordinary response to the manured mixture applied, but if that is a correct assumption, it is not clear why the Tea germination does not correspond. Assuming for the moment that the same number of weeds as were produced by these samples could be grown on an acre of ground treated in the same way, and comparing it as manured and unmanured, the figures are particularly striking as will be seen by the following table :

Unmanured Sample	A.	=	143 weeds	=	7,413,120	weeds per acre
Manured sample	A1.	=	276 ,,	=	14,824,424	do
Unmanured sample	B.	=	Nil			
Manured sample	B1.	=	2 weeds	=	113,788	do
Unmanured sample	C.	=	11 ,,	=	638,880	do
Manured sample	C1.	=	4 ,,	=	245,984	do

It will further be seen by the foregoing, that the manured Forest soil gives practically double the weed crop that the unmanured did, and it is difficult to assume that this result is not due to the stimulus received by manuring, when we observe its effects spread over the different orders into which the weeds are classed.

The following table shows this clearly in some—

FOREST SOILS.

ORDER.	Manured.	Unmanured.
	Weeds per acre.	Weeds per acre.
Compositæ ..	12,761,464	5,806,0[illegible]0
Geraniaceæ ...	270,370	362,880
Cruciferæ ...	54,074	51,840
Amarantaceæ ...	324,444	——
Araceæ ...	757,046	311,040
Cyperaceæ ...	108,140	155,020
Gramineæ ..	594,770	414,720
Commlinaceæ ...	——	51,840
Rutaceæ ...	——	51,840
Euphorbiaceæ ...	——	103,680
Umbelliferæ ...	54,074	——
Unclassed ...	——	103,680

These figures, however, are only arrived at by multiplying the superficial area of the sample plot by the crop turnon, so that where the sample plot is very small, as in these cases, the ratios when extended to an acre would tend to magnify deficiencies just as much as individuals, but nevertheless it is difficult to come to any other conclusion than that manure affects weed growth to a very remarkable degree, and it then becomes a matter for consideration if the weeds do not absorb more of the manure than does the plant for which the manure was intended.

Another question suggests itself, namely the relative rates at which plants are capable of assimilating manure, and from this arises the further deduction that, if weeds can absorb manurial matter faster than the plant to be benefited, what proportion is left of the manure for the purpose for which it is applied ?

Closely involved with these problems is that of root periodicity, i.e., the period when feeding roots are at their maximum of development, and their readiness to absorb plant food.

The relationship of electrical condition of the air to root formation is probably also a factor in the case, and it has important bearing on the point of what is the right time of the year that manure should be applied, and how far does this apply to different species of economic plants ?

I regret that circumstances beyond my control prevented my conducting my experiments over a whole year, but it suggests itself that these might be so arranged in order to show the variations produced by applying manure at different times of the year.

My experiment, however, was mainly to observe the effect of a rich manure on the growth of Tea, from the seed, and not on the Tea already growing.

SOILS AND MANURES.

NOTES ON THE CULTIVATION AND MANURING OF COCONUTS.

TRENT VALE.

No other crop in the world responds more gratefully to manuring than the coconut.

The difference between an estate which has been systematically cultivated and judiciously manured and one on which the palms have been left to their own devices, without any assistance in the way of tillage and the addition of plant-food, is apparent at the first glance.

On an uncultivated and unmanured estate the palms are invariably stunted and poorly developed, the foliage scanty and yellow in colour, and the few nuts scattered here and there amongst the trees give promise of little by way of a paying harvest. On the other hand, estates on which the soil has been ærated by frequent cultivations and enriched by periodical applications of manure present a vastly different appearance. The palms themselves are lusty and vigorous, the crowns a wide spread mass of glossy deep-green foliage, and every flowering stalk is thickly covered with nuts.

There are also several other very important differences between a cultivated and an uncultivated estate which are not so immediately apparent to the eye. In the first place, a cultivated and manured estate withstands the adverse effects of a period of drought far better than one which has been neglected. In the cultivated estate the roots are much deeper in the soil, they have a much greater range in which to search for moisture and plant-food, and the soil itself invariably contains more moisture than an uncultivated estate.

Secondly, the fall of young immature nuts is much less upon a cultivated and manured estate. The fall of young nuts is the source of very serious loss to the coconut planter and anything which can be done to prevent it is worthy of his closest attention. The premature fall of nuts is brought about by the weakness of the slender stalk which connects the nut to the flowering spike. On neglected estates these stalks are feeble and brittle the consequence being that many of them snap when the palm is shaken by the wind or when the growing nut is pushed aside by a more robust neighbour. On those estates which are cultivated and manured these stalks are much more strongly developed and they are also far more supple with the result that they merely bend instead of breaking when they are subjected to extra strain.

Thirdly, the meat of nuts grown upon cultivated and manured estates is much thicker and heavier than that of nuts grown upon neglected estates, the former therefore require fewer nuts to produce a candy of copra and they command a higher price when sold direct to the desiccating and oil mills.

* * * * *

The proper time to commence to manure coconuts is when the young seedlings are transplanted from the nursery to the field.

This is a critical period in the life of the young palm when it is naturally in a weakened condition, this disability being brought about by two distinct causes.

In the first place the food in the form of the meat in the nut is at this time on the point of being exhausted. When the embryo commenced to germinate it was supplied with a lavish store of food upon which it could draw freely, and this enabled it to put forth a number of roots and a few green leaves. But the time soon comes when the growing plant has consumed the whole of the meat contained in the seed-nut and thenceforth it has to fend for itself. It is now weaned, and from this time onwards the only food it can obtain is that which it is able to extract from the soil and from the atmosphere.

This change over in the source of the food supply is a critical period in the life of all young things, both animal and vegetable, and at no other time in the whole course of their existence do they benefit so greatly by a supply of food-stuffs suitably chosen to meet their special requirements and to enable them to weather this transition period successfully without being unduly checked in their development.

Secondly, it is just about this time that the young palms are removed from the nursery to their permanent situations in the field. The transplanting of young seedlings is of course an essential practice in successful estate management chiefly because it enables the planter to select his future palms; he takes advantage of this opportunity to stock his fields with robust young plants and to reject those which shew signs of feebleness and of unsatisfactory growth. Nevertheless, the removal of the seedling from one spot to another, however carefully it may be done, inevitably causes a temporary check in the growth of the plant. The tender roots have to be cut back, otherwise they die back from the ends, and thus the plant is temporarily deprived of the greater number of the feeding portions of its roots.

For these principal reasons everything possible must be done to succour the young palms during this particular period and, if the following rules are carefully observed, it will be found that the seedlings will rapidly recover from the set-back brought about by the change in the source of food supply and by the removal from the nursery to the field.

The holes which are intended to receive the young palms should be dug two or three months before the time of transplanting, and they should be in the form of a cube with sides of three feet.

These holes should be left open until a week before transplanting takes place when they should be filled to a depth of two feet with surface soil collected from around the holes. With this surface soil should be mixed a small quantity of soluble and readily-available plant food which will nourish the tender seedling at the precise moment at which it specially requires such assistance.

It is a common practice in Ceylon to place quantities of cattle manure and ashes in these holes but in doing so the vitally important point is entirely overlooked that neither of these fertilisers is of any use to the plant for some considerable time after it has been placed in the soil.

A number of complicated chemical changes have to take place before the food in these manures is rendered available and until these changes have been effected the plant can make no use whatever of them. Both cattle manure and ashes are excellent forms of fertilising material when used at the proper time and in the proper way, but so far as the young seedling is concerned at the time of transplanting they might just as well not be placed in the holes at all for all the good they do.

The case is vastly different when small quantities of concentrated and immediately available plant-food is mixed with the soil in the holes. Such fertilisers have only to enter into solution in the soil moisture and the plant can at once commence to feed upon them. By the time the actual transplanting takes place, therefore, the soil in the holes will be impregnated with available plant-food which will be taken up by the roots immediately the absorbing tips come into contact with it.

For this purpose no better mixture could be devised than the following :—

	Nitrogen	*Phosphoric acid*	*Potash*
150 lb. Superphosphate		27 lb.	
150 ,, Nitrate of Soda	23 lb.		
50 ,, Muriate of Potash			26 lb.
350 ,,	23 ,,	27 ,,	26 ,,

Application :—2 lb. of the above mixture to be incorporated with the surface soil placed in each hole.

This mixture is of a fairly concentrated nature, containing between six and seven per cent. of each of the fertilising materials, nitrogen, phosphoric acid and potash, and all the plant-food is in an immediately available form so that there is no question of any delay being incurred before the seedling can make use of it.

By applying two pounds of this mixture to each young plant a total of a little over one hundredweight per acre is required the cost of which is trivial compared to the immense assistance it affords the seedlings at just that one time above all others when such assistance is most beneficial and most necessary.

About one week after the holes have been filled to a depth of two feet with surface soil impregnated with artificial plant-food the seedlings should be transferred from the nursery. Naturally only the sturdiest of the youngsters should be selected for transplanting and these should have their roots trimmed back a few inches with a sharp knife. They should then be planted out in the specially prepared holes so that the top of the seed nut is just about six inches below the ordinary level of the soil. No advantage whatever is gained by planting the seedlings any deeper in the soil than this, in fact the development of the young plant is greatly retarded by over deep planting.

The seed nut itself should be completely covered with soil and the earth should be carefully pressed firmly round the nut by hand.

The holes will now be about five inches deep with the well developed leaves of a robust young palm growing from the centre of each hole.

While the growing palms require a constant and adequate supply of moisture it is a great mistake to allow stagnant water to lie in the holes. To prevent this, where the slope of the land permits, small gullies should be cut to carry away any excess of water, while in flat fields where such gullies are impracticable the holes must be filled up to the normal level of the soil so as to prevent water from remaining round the plants.

The next thing to do is to protect the palms from grazing animals and this is probably best effected by erecting stout walls of husks four or five feet away from the plants well outside the spread of the leaves.

The soil inside these walls should receive constant tillage by forking to a depth of at least six inches. The importance of this cannot well be exaggerated. Such tillage not only ærates the soil and conserves the moisture but it also ensures that the roots will develop deeply in the soil right from the very commencement. The roots of the palm, like the roots of all other ordinarily cultivated plants, must breathe. If cultivation is neglected the soil becomes compact with the result that air is excluded from all but the top inch or so of soil the consequence being that the roots are forced upwards and are confined to the surface layers only, this being the only place in which they can breathe. The evil effects of this state of affairs are manifold. During periods of drought the roots suffer severely from the scorching sun, they are parched by the lack of moisture—the top two inches of soil being invariably the driest, except of course immediately after rain—and they can search for plant-food only in a very restricted portion of the soil.

Moreover, when once this condition has been allowed to develop it is an exceedingly difficult business to rectify it. The roots will be confined in the form of a thick mat in the top three inches of soil and to plough or dig the whole estate in this condition would be to cut every single root into a hundred pieces. If such a process did not actually kill the palms it would at least inflict upon them such a severe check that it would take them several years to recover from it.

However, if these roots have been kept down to the proper depth by adequate forking and, later, by ploughing, this difficulty will never arise and the palms will develop quickly and strongly.

When the above programme is carried out carefully and thoroughly the planter has the satisfaction of knowing that everything possible has been done to give his young charges a good start in life, and he can look forward to the future development of the palms with confidence and assurance.

We have now to consider the treatment of the estate during the time which must elapse before the palms come into bearing.

* * * * * *

"All coconut growers are strongly advised to pay careful attention to the cultivation of their young palms. If this were done plantations in Ceylon would not take an average of ten years or more to come into full bearing."

The above paragraph is extracted from an article written by the Director of Agriculture, published in the November issue of the *Tropical Agriculturist*, dealing with the excellent results obtained from the early manuring of coconuts on the properties of two well known coconut planters.

This article, together with the illustrations which accompany it, should receive the close attention of all interested in coconut cultivation. It will amply repay study.

During the twelve months following the transplanting of the seedlings from the nursery to the field the soil should be cultivated at frequent intervals and kept free from weeds.

The cultivation of the soil is absolutely essential for the production of the maximum development of the young palms. By the repeated stirring of the soil to a depth of four to six inches the moisture is conserved and prevented from evaporating, rain water soaks downwards into the soil instead of running off the surface into the drains, air is drawn downwards into the soil in the wake of the descending rain, and the roots of the palms are kept out of the hot dry surface layers and made to develop deep in the soil where a far greater supply of moisture and plant-food are at their disposal.

The actual amount of cultivation which is carried out during this year will of course be governed by the size of the new clearing, the amount of labour and the number of cattle available for the work. To obtain the best results the land should be ploughed at least three times during the year and harrowed three times also. This would mean that the soil of the new clearing would be turned over and stirred six times during the year and the beneficial effects of such cultivation upon the palms would more than repay the expense incurred.

As a matter of fact the expense involved is very small on those estates which are possessed of a resident labour force and a number of trained cattle, while the increase in the development and vigour of the palms following upon such treatment has only to be seen to be immediately appreciated.

A further effect of such cultivation will be the destruction of weeds. Weeds and grass are a pest upon all coconut estates—with the exception of grass grown upon steep slopes to prevent soil erosion; they increase enormously the loss of soil moisture, they rob the land of valuable plant-food and they prevent the penetration of air into the soil. But they are particularly harmful in the case of new plantations. The young growing palm requires everything it can get in the way of moisture, plant-food and air and to allow utterly useless weeds to have a share in these good things must obviously result in retarding the development of the palm.

One year after the transplanting of the seedlings they should receive another small dressing of fertilisers to assist them in their growth.

This dressing should take the form of the following mixture :—

	Nitrogen.	*Phosphoric Acid.*	*Potash*
200 lb. Fish Guano	15 lb.	17 lb.	
150 ,, Nitrate of Soda	23 ,,		
150 ,, Superphosphate		27 ,,	
100 ,, Muriate of Potash			52 lb.
600 ,,	38 ,,	44 ,,	52 ,,

Application :—4 lb. per palm.

This mixture is of the same nature as that used at the time of transplanting except that it contains a good proportion of organic fertilising material in the form of Fish Guano.

Fish Guano shares with the true guanos the property of continuing to yield nitrogen to the plant throughout the whole growing season, a property which makes it a particularly useful form of fertiliser. In addition to this it contains a valuable proportion of phosphoric acid.

Both these plant foods, nitrogen and phosphoric acid, are supplemented by the other manures which provide the plant with nourishment more quickly than organic fertilisers. The Nitrate of Soda provides an immediately available supply of nitrogen and the superphosphate an equally available supply of phosphoric acid. The palm's requirements as regards potash are met by means of the Muriate of Potash which is included in the mixture.

This mixture of manures should be applied to the palms in semi-circular trenches dug not less than three feet away from the base of the trees.

Precisely the same treatment should be given to the palms during the following four or five years as was given during the first year. The soil should be stirred as frequently as possible, more especially during dry weather, and the same manure mixture should be applied in quantities increasing by one pound per palm per annum up to a maximum of eight pounds per tree.

The only important difference to be observed in the treatment of the estate lies in the method of applying the manure to the palms.

It is frequently insufficiently realised that plant-food applied in the form of manure can be made to serve a very useful purpose altogether apart from the actual nourishment which it supplies to the plant, this purpose being to strengthen and to encourage root development.

The roots of the coconut palm spread out radially from the base of the tree and subdivide into smaller and more numerous branches as they grow outwards. Plant-food is absorbed by only a small portion of each tiny rootlet, the absorbing area being situated at the tips of the branches immediately behind the root-caps.

Therefore the further away from the palm the manure is applied—provided that the limit of actual root extent is not exceeded—the more feeding tips will it come into contact with and the more readily will it be absorbed by the palm. And the root development which invariably follows an application of manure will be vastly greater when the application is made at a good distance from the palm than when it is made near the base. Not only are there greater numbers of roots to branch and to subdivide but also the area of soil in which they can develop is proportionately greater. The result of this is that when all the manure has been absorbed the palm is possessed of a greatly increased and strengthened root system through which it is brought into contact with a far larger number of soil particles and thus is able to extract very much more plant-food from the soil.

When properly applied the effect of manure is permanent. While the manure is being absorbed the root system is rapidly increasing by the subdivision of the branches and when it has been completely consumed the newly developed rootlets continue to supply the palm with an increased supply of food extracted from the fresh areas of soil into which they have penetrated.

One occasionally hears it said that if you commence to manure coconuts you have to continue to do so; otherwise the palms "go back."

Where palms do go back in this way it will invariably be found that the manures have been incorrectly applied in such a way that little or no permanent root development has been encouraged. This frequently happens when cattle are tied to the palms for the purpose of supplying them with manure. The manure falls within a few feet of the base of the palm and sooner or later a thick mass of fine hair-like roots develop. Now, if only these roots were sufficiently deep in the soil and if only they had sufficient room in which to grow they would be of immense benefit to the palm. But as a matter of fact they are of very little temporary use to the palm and later on they become actually harmful. They grow right up to the surface of the soil, where they are subsequently scorched by the sun or destroyed by cultivation, and they are so crowded together right in near the base of the palm that they have relatively very little soil from which to extract water and mineral plant-food.

The ultimate result of this is that these newly developed roots die and the palm consequently receives a severe set-back.

Much the same thing is liable to occur when the walls of husks, originally built to protect the young palms from injury by cattle, are left in one position too long. The roots of the palms are encouraged to grow upwards in search of the plant food in the rotting base of the wall and, when eventually the wall is cleared away, a circular belt of tender roots is left at the surface of the soil to be scorched and killed. All this can be prevented by applying the manure in the proper way, that is to say in the proper place and at the proper depth.

Obviously the place in which the roots have at their disposal the greatest area of soil in which to develop, and from which to obtain plant-food, is midway between the rows of palms, and everything possible should therefore be done to encourage deep and vigorous root development in this area.

Provided that the young plantation has been cultivated and manured the roots of the palms four years after transplanting will have developed outwards to such an extent that those from one row of palms will meet and intermingle with those of the adjacent rows, and from this time onwards semi-circular trench method of applying the manure should be discontinued and all future applications should be made along a broad strip down the centres of the rows. If artificial manures are being applied all that it is necessary to do is to broadcast the mixture by hand and then plough it under, while if the land is being dressed with cattle manure this should be placed in long trenches three feet wide and six inches deep dug down the centre of the rows.

Now, provided that the young plantation is reasonably fortunately situated in a district where the soil is fairly good and the rainfall adequate as regards both quantity and distribution the palms, if treated in the manner outlined above, will commence to bear nuts in the sixth year after transplanting and the yield will increase rapidly from year to year.

* * * * * *

Very special treatment is required in the case of old estates which have not been previously cultivated or manured.

On these estates it will almost always be found that the soil is very hard and compact and that the roots are matted together in the top two or three inches of soil.

As noted previously, to plough an estate in this condition would mean cutting through practically every single root, a procedure which would have a devastating effect upon the palms. Heroic measures are both useless and dangerous, the work must be taken in hand carefully and gradually.

The first thing to do is to break up the soil and thus allow water and air to penetrate into the lower layers, and this must be done without breaking any large proportion of the roots.

The most effective way of carrying this out is by the use of long-tined forks. The forks should be driven right down into the soil, to a depth of eight or ten inches if possible, and pushed backwards and forwards until the crust of earth immediately round the fork is thoroughly broken up. The soil should not be turned over as to do this it would first be necessary to break the roots which is just what should be avoided. After being thrust backwards and forwards a few times the fork should be pulled straight out and driven into the soil in a fresh place.

Alternate rows only should be treated in this way at first, and when the field or the estate has been completed then the rows which were missed on the first occasion should be similarly forked.

The effect of this will be that the rain water will sink down into the soil, drawing air after it, and thus new layers of plant-food will be placed at the disposal of the roots, a condition of which they will rapidly take advantage by sending down young rootlets into the fresh areas.

The entire estate should be forked in this manner at least twice during the year, and the same process should be repeated twice again during the second year.

After this it will be quite safe to put the ploughs into the soil, and this should be done as frequently as possible during the third year, the only precaution to be taken being to plough alternate rows first and to allow three or four months to elapse before the second rows are ploughed. If this ploughing is done effectively it will result in the complete destruction of the grass and weeds, a very important point in connection with the welfare of the palms.

During the third year work should be commenced on burying husks. Trenches should be dug three feet wide and three feet deep down the centre of alternate rows, and these should be filled with husks, sprinkled with lime or basic slag, to a depth of two and a half feet, the top six inches being filled in with earth.

Applications of manure should be made annually commencing with the year during which the ploughs are first used, the mixture being the same as is prescribed above.

This special method of cultivation carried out over a period of three years will effectively break up the hardened soil and will result in a very considerable development of the roots of the palm in the deeper layers. Many of the older roots will be broken but not before the palm has been stimulated into producing fresh and vigorous root-growth.

Once a fine tilth has been obtained in the surface layers every care should be taken to preserve it and to prevent the soil from again setting into hard cakes.

Henceforth the old estate should be treated in the same manner as that detailed above for young plantations; the soil should be ploughed and harrowed as frequently as possible, the light harrows being kept busy every day during the dry weather in order to break up the surface and to prevent as far as possible the evaporation of the soil-moisture, and the estate should be dressed once a year with the mixture of manures at the rate of eight pounds per palm.

COFFEE.

GRAFTING IN COFFEE CULTURE.

DR. P. J. S. CRAMER.

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(Continued from the March Number.)

THE DIFFICULTIES INVOLVED.

After summing up in the previous chapter the points in favour of grafting we ought to bring forward now the difficulties bound up with grafting operations. One of them, an important one, was referred to at the beginning of this article; grafting demands more deliberation and forethought of the planter; the execution of the process and the laying out of the estate often present difficulties. In the beginning it is not easy to procure a sufficient number of scions or to obtain the satisfactory type of stock. That this difficulty is not insuperable is clearly illustrated by the existence of such large grafted estates as Kawisari, the trees of which are all grafted from one parent tree; there are on this estate a couple of hundreds of bouws of hybrid grafts too in production. Whilst admitting that these difficulties exist, I am not of opinion that this demand of greater attention, provision and labour of those in the industry is anywhere so great as to make it impossible for them to meet it. I consider it advisable while warning my readers once again against this prejudice to warn them also not to underestimate the difficulties that will offer. Continued attention should be devoted to the development of the stocks: experience teaches very often that in many cases sufficient regard has not been paid to them. What planters often hope to achieve with the use of certain selected grafts is, to a great extent, dependent on the stock; and good nursing and care of the stock, which does not cost much, will amply reward him by its contribution to his success.

The difficulties involved in the work, the extra labour, forethought and attention naturally augment the prices of grafts which are higher than those of seedlings. When all items of expenditure are taken into consideration—the cost of the stock, the gathering of the scions and the loss in the crop entailed by the excision of offshoots, the loss from unsuccessful grafts, the emoluments of the grafter, the depreciation written off for the reacting tubes, and other such like expenses—grafting will certainly be found much more expensive than the usual method of raising nursery plants from seed: what is more, the demand the grafted plants make on the time of the planter who has to bestow on his young nursery extra attention and a deal of forethought should be taken into the reckoning. Bangelan at present raises grafts which are given at 15 cents each when the order given is for a number less than one thousand, and you may depend upon it that there is not much made in the way of profit.

DISAPPOINTMENTS FROM UNSUITABLE PARENT TREES SELECTED.

A second difficulty arises from the variation of the fitness of different parent trees for grafting which I have spoken of before. Regularity in this regard can be greatly achieved by selecting scions from trees of one sowing. One might be apt to conclude that scions from trees of prolific and vigorous growth grafted on scions having this same characteristic will all the more easily fuse together and flourish soon for one might think that they are the two fit types to be brought together for the purpose; but results of experiments show that our assumption is not correct. Quillou, for example, on Bangelan, is the most vigorous grower with great strength of trunk and branches when grafted with a scion of one of the Robusta varieties; but many Quillou parent trees however seem to be rather unsuitable as in but a small percentage of the grafts did fusion take place. Scions from several parent trees of Excelsa and of Dybowskii which is closely allied to it are very difficult to graft with successfully, although both the species are very vigorous growers. The plants of garden No. 126 which are all raised from seed of Excelsa can be cited as telling examples. In a very remarkably beautiful seedling plantation of No. 121 which is at present 14 years old, a number of parent trees was selected in 1914 originally for the purpose of laying out a new plantation of seedling stock. Soon after, the same trees served also for getting scions from for grafting experiments. These parent trees, of the same sowing gathered from one tree, behaved differently one from another. The scions of No. 121·09 when used for graft experiments offered great difficulty as they did not fuse easily with the stocks. Out of a number of 80 graft experiments carried out, as HEER PARKINSON said to me, hardly a dozen were successful. Scions from No. 121·13 on the other hand were very suitable and combined easily with the stocks. A great number of very well spliced and successful grafts of No. 121·07 which have been planted in a plot along with seedling stock of seeds obtained from the same parent tree testify to the fact that scions of this parent tree are very favourable for grafting.

In contrast to these vigorously growing plants which are often difficult subjects for grafting there also exist rather weakly growers which easily splice and succeed when grafted. Congo coffee which on its own roots is one of the weakest species, often being of a pale yellow colour, and by the dark colour of its branches and the small leaves reminding one of the resemblance it bears to Arabian coffee, easily picks up and becomes a vigorous, well foliated and beautiful tree when it is grafted. Canephora and Uganda are generally easy to graft.

Grafts of hybrids are generally the best for successful grafts. This is true even of the most heterogeneous combinations. On Bangelan for instance successful grafts have been effected by Excelsa x Liberica Congo x Uganda, Liberica x Arabica, Robusta x Magrogipe, Robusta x Liberica, Stenophylla x Abeokuta, Canephora x Robusta, Robusta x Quillou; and it has already been shown that these hybrids are very successful as grafts.

I should not fail to add that in the case of all the graft experiments the stocks certainly play an important part, and that some varieties, for example, scions of a certain definite Robusta parent grafted on an Excelsa stock, succeeds with difficulty, whilst the same on stocks of a Robusta type easily splice and flourish.

THE INFLUENCE OF THE SCION.

In many cases the scion itself seems to exercise unfavourable influences on the tree. The leaf disease appears to have a greater hold, and the drought-resisting capacity of the tree is greatly diminished. This is a very important point and we should dwell on it a little more fully since it is the centre round which all other issues gravitate in trying to arrive at a decision whether grafting can, when resorted to on a large scale, improve the coffee trees of the estate.

In order to study perfectly the exact kind of influence the scion exerts on the tree, one plot should be laid out with seedling stock and another from the same seed as the trees on this plot, corresponding exactly with it, and grafted, plant for plant, with each of the other. This experiment has not up to the present time been undertaken, but it will be undertaken later on Bangelan when opportunity offers. We have made an experiment similar to it: corresponding with a number of parent trees of the Robusta types a set of grafted plants raised from one particular parent plant was laid out and compared with sets of plants on an adjoining division whose plots were raised from ungrafted seedling stock of one parent tree. In the table given below the figures given show the products given by each series. It will be noticed that in every case a plot raised from seedling stock is compared with a grafted one. In the table the grafted plots are indicated by the sign + before the figures showing their produce. It may be noticed for example that plot No. 350 was planted during the West monsoon of 1917-1918 with grafts of Bukobensis while plot No. 534, which lies just by it, was planted at the same time as its neighbour but with ungrafted seedling stock of one parent tree. Besides, in another part of the experiment station, during the course of the following year, two more plots were laid out with seedling stocks selected from one parent tree: No. 317a and 315b.

Table II.

Comparison of grafted plants and plants raised from seedling stock of the Robusta types (Products given in Kg. market coffee per bouw.)

Plot Number	Bukobensis	2-01	Size	1921	1922	1923
+350	December	1917	0·068	174	639	243
534a	,,	,,	0·231	451	1,001	423
317a	,,	1918	1·123	287	822	590
315b	,,	,,	0·384	348	763	546
516/17	Uganda	2-13	0·097	417	407	530
357	,,	,,	0·066	491	326	456
526	Iaurentii	3-02	0·063	229	850	465
528a	,,	,,	0·233	1,045	625	230
535/36	Quillou	7-02	0·074	408	829	137
312a	,,	,,	1·050	81	1,212	317
313a	,,	,,	0·835	408	1,455	302
523	,,	7-02-01	0·068	425	741	321
314a	,,	,,	0·745	173	644	183
315a	,,	,,	0·312	89	812	217

If we were to compare the amounts of the crops in Bangelan for the different years it will be noticed that 1919 and 1920 were years in which poor crops were gathered ; in 1920 the crop completely failed, the average for the whole station in figures generously stated being about one picol per bouw. This failure in the crop is wholly due to the pest which descended so ravageously on the whole estate that it injured the trees and by degrees destroyed the blossoms. In 1919 and 1920 the coffee berry-beetle too infested the estate heavily and created much damage. "Rampassons"—total destruction of the berries—of many plots had to take place. The year 1921 was a fairly favourable year ; 1922 brought in a good harvest ; and in 1923 the crop again diminished to some extent.

What do we notice now when we compare grafted plots with ungrafted ones. In the first series, the case of Bukobensis No. 2·01, the plants raised from seedling stock and ungrafted give larger crops than the grafted plants; in 1920 they gave 451 kg. per bouw as against 174 kg. of 243 kg. of the products of grafted trees. In 1921 they gave 423 and 243 kg. Even the plots raised from seedling stock a year later gave much more than these grafted plots.

In some parallel instances however grafted plots give more, often considerably more than plots raised from seedling stock. Canephora No. 15·03 for example is one of these. One of these grafted plots was laid out at the end of 1917 and the other at the end of 1918. Both these plots are far more productive than corresponding plots raised from seedling stock.

Table III.

Comparison of Canephora grafted and ungrafted plots. Products are given in Kg. of market coffee per bouw.

Plot Number.			Size	1921	1922	1923
	Canephora Djati Roenggo 2 02					
+522	December.	1917	0·068	159	402	242
569	,,	,,	0·463	228	687	417
	Canephora Vart. Quillou 4 02					
+524	December	1917	0·068	260	1515	335
564	,,	,,	0·422	230	823	595
+615 a	,,	1918	0·119	79	1125	200
	Canephora 15·03					
+524	December	1917	0·068	768	615	304
566	,,	,,	0·453	267	551	456
+612 a	,,	1918	0·094	113	1435	705
	Canephora 20					
+514/15	December	1917	0·136	583	1157	419
571	,,	,,	0.419	355	1069	599
	Canephora 21					
+533	December	1917	0·068	231	781	256
565	,,	,,	0·451	381	517	356
	Canephora 30·08					
+520/21	December	1917	0·136	405	1130	241
567	,,	,,	0·450	203	527	395
613 a	,,	1918	0·094	35	319	398

Table IV.

Comparison between the products of Robusta grafted and ungrafted plots. Products given in Kg. of market coffee per bouw.

Plot Number.			Size	1921	1922	1923	Total
	Robusta 27—						
+ 532	December	1917	0·068	808	890	722	2420
575	,,	,,	0·467	336	857	529	1722
	Robusta Bajoe—Lor 25						
+ 525	December	1917	0·068	333	1421	410	2164
578	,,	,,	0·469	478	919	742	2139
	Robusta Bajoe—Lor 2						
+ 540	December	1917	0·068	652	914	533	2099
576	,,	,,	0·446	315	674	476	1465
	Robusta Kali Glidik 2						
+ 525	December	1917	0·068	181	706	707	1594
556	,,	,,	0·468	209	687	647	1543
	Robusta Tjandi Sewoe 17						
+ 525	December	1917	0·068	356	1017	201	1574
529	,,	,,	0·467	145	550	336	1031
	Robusta Soekarme 23						
+ 527	December	1917	0·068	159	601	91	851
581	,,	,,	0·460	194	752	442	1388

Table 4 shows records of such experiments with reference to Robusta. The productivity of grafted and ungrafted trees when compared seems nearly alike although in the table given, only in one case, the last, are the figures for ungrafted coffee higher than those for the grafted plots. Though in every case but one the figures for grafted coffee is higher, the totals of the products of the plot nearly tally.

The figures given in the tables made up so far are not sufficient to give us a complete idea of the relative productivity of grafted and ungrafted trees. To arrive at the desired evidence I shall give another example bringing up again thereby into prominence a few points which once were very important considerations. I chose for this purpose a Robusta plantation, No. 105, which was laid out for the purpose of the comparative study. This mother tree is one of the most beautiful of the Bangelan trees. For a tree raised from seedling stock it has done very well consistently. In coffee estates of different parts and under varied conditions people who planted its seed have been so pleased with it that they repeatedly made requests for seed of that particular tree. The plots raised from the seedling stock of this parent plant are, in Bangelan too, very productive. The berry of this tree is large. The descendants of this tree have to such a high degree the general robusta characteristic of resistance to leaf disease that these plots have never been attacked by it. The parent tree itself and all its descendants have year after year brought forth abundant crops.

As soon as the experiments on grafting had got a fair pace in Bangelan we specially laid out a large plantation of grafted plots of which this tree No. 105 was the parent. Our chief motive in the making of these plots was to use the trees as seed-bearers. This being the case, we have from Robusta No. 105 a wealth of statistical information in connection with the relative productivity of grafted and ungrafted trees. These figures are shown in Table No. 5.

Table V.

ROBUSTA 105.

Products of the Ungrafted Plots(in Kg. market coffee per bouw).

Plot	Planted in	Bouws	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
38	Dec. 1909	0·670	893	313	1103	1418	1433	1084	496	179	3113	1016	737
217	Jan. 1913	0·500			510	2013	1241	1750	10	15	694	962	657
218	do	0·500			548	1728	995	1534	11	26	661	800	493
238	Jan. 1914	0·209				309	1156	1464	244	134	1162	855	993
239	do	0·416				479	1805	1608	141	89	1505	1181	1090
240	do	0·536				453	1870	1819	154	86	1255	1405	788
241	do	0·295				295	1172	1318	156	111	940	1145	594
24a	Dec. 1912	0·386			1844	1763	2008	847	632	92	2307	1318	756
	Products of Grafted Plots (Excelsa stocks).												
527	Dec. 1917	0·068									1	1120	143
	,, 1918	1·514									82	968	233
	,, 1919	1·559										248	443
	,, ,,	1·511										54	366
	Grafted Plots (Uganda stocks).												
120	Field grafted when adult	0·184									73	565	366
	Product of Parent Plant (in Kg.)												
1	Dec. 1901					4·230	6 279	4·238	6·598	5·218			

What have we now learnt by comparing the figures showing the products of the grafted plots raised from this parent tree? They were planted in January 1919 and January 1920. At the beginning they seemed brilliant, and as regards its growth there seemed to be nothing more that could be desired; the plantation, by its beautifully fresh appearance, its regularity, and vigorous development, so attracted the attention of all who beheld it that we really thought it would be one of the very best of our plantations in Bangalen. When, however, the trees began to bear, our hopes were all dashed down. Immediately after the first harvest, they began to display the symptoms of trees suffering from the effects of over-production; the appearance of these adverse symptoms were all the more to be regretted as the product brought forth was not at all high enough to justify their appearance on a good plantation. The small grafted plantation laid out at the end of 1917 or the beginning of 1918 gave in 1921 almost no crop; in 1922, the fifth year, it produced 1,120 kg. per bouw, which is yet only 19 pikol—not very high figures surely even for a normal plantation. The larger graft plot laid out one or two years later behaved much worse. The figures for the youngest "hectaretuinen" are so low that one might be inclined to attribute it to a failure of the crop; yet if you examine the trees they seem to be suffering from the effects of over-production.

This is the condition of things that obtains not only in the plantations laid out with grafted material which had undergone the process of grafting on the nursery beds, but also on the plots where the grafting was carried out on the open field when the trees were fully grown as in the case of the

Uganda stumps that were used as stocks. Here too the figures showing the amounts of crop produced are far below those of the good robusta plots on Bangelan. The product of 10 picols per bouw is never reached. In addition to the low production these trees in other ways too can hardly claim merit; they are not of good habit and appearance; they are sparsely foliated or have wholly defoliated branches and show many of the after-effects of the leaf disease.

The figures showing the productivity of the parent tree are on the other hand very good. In the period between 1913 and 1918 this tree produced on an average 5·686 kg. per year. The plantation raised from seedling stock descended from this parent show in like manner a capacity for heavy production. Crops of over 30 picol per bouw were gathered in some years; and these produced so much as fifty picols per bouw. The remarkable uniformity of the quantity of the crop produced—which was maintained even in the years 1919 and 1920 when there were bad failures—is very striking.

We shall later bring up instances of a number of other examples of grafted plants, descended from very productive Robusta parent trees, that bear very badly and are unsatisfactory. Among the examples of such disappointments which have continually occurred in Bangelan as a result of the experiments carried on there, there have been noticed some trees which seemed to have imbibed from the grafted scion alone all its undesirable characters; other instances have been noticed of these scions, of a parent tree that gave rise to unsatisfactory grafted tree, turning to very good account indeed over a different stock. Herein then lies the cause, very probably, of the phenomenon: the failure of the tree to produce well is to be attributed to the influence of the stock on the tree. Robusta when grafted on certain varieties fare less satisfactorily than when grafted on others ; on Excelsa, however, scions from Robusta parents are altogether unsatisfactory.

Speaking of the influence the stock has in settling the character of the tree, brings me back to the next point—the third disadvantage which might be cited as a strong point against grafting—which I shall deal with, leaving this matter alone for some time till I come back to expatiate on it more fully. The third point is this : the scion itself in many cases very clearly exhibits the degenerating influence it excercises on the grafted tree. The tendency of grafts for exercising this bad influence can in a good measure be counteracted by the happy combination of stock and scion. In the case of every species, certain parent trees should be used to combine with stocks best suited for them.

The last argument against grafting I bring forward is the fact that of a number of graft experiments carried out, a certain percentage of them always fail, or get spliced slowly and badly. In spite of all I have said with regard to the uniformity of grafted trees in their condition and habit and their quantity of production, we are yet left with a few deficiencies : in every large estate of grafted coffee two to three years old there will always be noticed among the plants a certain number of individuals that are much inferior to the rest. They hardly put forth branches ; the leaves assume a pale yellowish colour ; and the slender stem of the plant, especially as it grows older, gets crusty and is covered by mossy growths on it. The whole plant conveys the impression of stagnation in growth. One might not be willing to take these symptoms as sure marks of deterioration of the trees but it is most advisable to uproot these and replace them by better plants.

The trees that are thus tardy in growth and are generally failures are usually those that did not get well spliced after the operation of grafting; but they are slightly better than those that entirely failed in the experiment. These plants occur in every grafted lot when fusion in some cases does not take place within the proper interval, and naturally th scion dies very fast

and dries up. Further, there occur a certain percentage of grafted plants in which the combination between stock and scion has not been perfectly established, not so imperfectly, however, as to entail the death of the plant. These plants, taken for well fused grafts, are planted out on the estate: but such badly fused grafts always remained, wherever we had occasion to notice them, in the same weakly state all their lives, and were never known to become vigorous.

Luckily the remedy for this evil is simple enough, as it consists only in uprooting the unsatisfactory plants when they are noticed by the planter as he takes his regular round of the plantation periodically—from shortly after the plants have been laid out till nearly a year after in order to examine the plants and estimate losses and vacancies on the plantation—and replacing them by good ones; it is in fact the same as what is done when ungrafted stock is used; if the plants do not strike in, they are pulled up and replaced. In the preparation of planting material, especially grafted material, one should not be sparing; one should see to it that there is ample stock in reserve to replace many such undesirable plants.

One should carefully distinguish between the appearance of such weakly tardy growers and plants that, as I have spoken of, have deteriorated owing to the unwholesome influence exerted on the plant by the stock. In the case of plants, caused to deteriorate on account of the stock being unsuitable, the undesirable characters are not evident in the first years; they in fact appear most luxuriant from the start, but show marks of their unhealthy habit and deteriorate only just after they have begun to produce. Traces of the deterioration can be noticed, however, when the plant is very young if one carefully examines it; and the practised eye is able to single out such plants even whilst they are on the nursery beds.

As mentioned before, these phenomena should be carefully studied. In other lands too, people have, during the past few years, given a good deal of attention to the variations which occur in planting material after grafting and budding. It is possible that, partly at least, what they put down for being variations are nothing more than what we have discussed above as the weak and tardy growers which owe their adverse characters only to the fact of incomplete success in grafting. The American experimentor, DR. WEBBER, one whose work has been surely of utmost service to others working in the same sphere, has been of opinoin that these variations are to be attributed to the fact that the vigour of growth of the different stocks is not the same. Till we gain wider and more comprehensive knowledge of the behaviour of stocks in general we prefer to refrain from discussing the results of the experiments made by this gentleman.

A recapitulation of what has already been said in the discussion on the arguments brought forward by me against grafting on a large scale can now be made: The first point urged was the additional labour and attention as well as the greater expenditure involved in the preparation of planting material; the second difficulty arises from the great variation of the fitness of different parent trees for grafting, even though they in some cases be originally descended from one parent tree; thirdly the scion exerts, in many instances, a detrimental influence on the growth of the tree in case the stock matched with it be not happily chosen and happens to be unsuitable for it to combine with; the fourth difficulty is the occurrence of a certain percentage of weak and tardy growers. As the discussion so far will tend to show, these difficulties, great as they may be, are not insurmountable or unavoidable. I am of opinion that we should try to overcome them by the selection of good stocks and by carefully combining a suitable stock to a suitable scion when preparing our material by grafting.

We shall devote the next chapter to the discussion of the question concerned with the stock.

CATTLE.

FEEDING EXPERIMENTS, BANGALORE.

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Experiment I.

The following feeding experiment was conducted at the Bangalore Military Dairy with the intention to see whether it benefited a dairy man to include 3 lb. of rice bran in his cow's ration. All the cows in the experiment were half-bred, their food was weighed daily, and they were fed in troughs. In some instances, a certain amount of stealing amongst the cows went on, but this could not be avoided owing to the construction of the troughs. There were two groups of six cows. Every effort was made to procure cows whose total weight, their number of days in milk and their total daily milk yield corresponded as nearly as possible.

The milk was weighed and tested for fat each morning and evening.

Each animal was weighed before the experiment and at the end of each week during the experiment and their weights recorded.

The rations fed to the two groups were as follows :—

	Group I.	Group II.
	Lb.	Lb.
Cotton seed meal	3	3
Wheat bran	3	3
Rice bran	3	—
Gram husk	2	2
Brewers grain (wet)	16	16
Salt	oz. 1	oz. 1
Silage	20	20
Green grass	10	10
Hay	5	5

Group I.

Number	Age	Daily milk yield before experiment commenced	Weight	Number of days in milk	Number of Calves	Date of Serving
	Y. M. D.	lb.				
834	3 1 12	23	800	59	1st calf	Not served
711	3 5 12	24	750	44	1st ,,	15th January, 1920
426	5 3 12	17	820	9	3rd ,,	27th January, 1920
429	5 2 12	22	720	58	2nd ,,	28th December, 1920
709	3 5 12	20	670	65	1st ,,	13th January, 1920
828	2 8 12	17	600	69	1st ,,	Not served
	Total -	123	4,360	304		

Group II.

497	4 5 12	20	810	95	1st calf	16th January, 1920
518	4 0 0	20	670	39	3rd ,,	17th January, 1920
513	4 1 12	24	880	79	1st ,,	Not served
714	3 4 12	19	530	21	1st ,,	Do
812	2 10 12	21	510	26	1st ,,	2nd February, 1920
549	8 0 0	19	570	41	4th ,,	31st January, 1920
	Total -	123	3,970	301		

WEIGHT OF COWS.

Group I.

Number	Weight at Commencement of experiment	Weight after the experiment	Increase or decrease in weight
	lb.	lb.	lb.
834	800	860	+60
711	750	750	—
426	820	840	+20
429	720	740	+20
709	670	730	+60
828	600	660	+60
Total -	4,360	4,580	+220

Group II.

497	810	860	+50
518	670	720	+50
513	880	890	+10
714	530	600	+70
812	510	580	+70
549	570	610	+40
Total -	3,970	4,260	+290

WEEKLY YIELD OF MILK.

Group I.

Number	1st week	2nd week	3rd week	4th week	5th week	Total
	lb.	lb.	lb.	lb.	lb.	lb.
834	159	152	148	153	147	—
711	181	180	178	168	154	—
426	140	155	157	161	152	—
429	152	146	149	147	140	—
709	148	139	144	147	135	—
828	137	136	123	130	129	—
	917	908	899	906	857	4,487
Fats Average per cent	M. 4·28 E. 5·41	M. 4·48 E. 5·35	M. 4·15 E. 5·04	M. 4·30 E. 5·08	M. 4·20 E. 5·18	M=Morning E=Evening

Group II.

497	143		134		136		130		129		
518	138		143		133		132		127		
513	160		156		159		156		146		
714	139		138		140		139		130		
812	144		141		145		140		136		
549	118		114		117		117		109		
	842		826		830		814		777		4,089
Fat per cent.	M.	E.	M.	E.	M.	E.	M.	E.	M.	E.	
	4·32	5·25	4·31	5·22	4·44	5·12	4·37	5·18	4·21	5·21	

From the above it will be seen that the total increase of milk of Group I. over group II. is 398 lb. in 5 weeks. If this milk is taken at the usual. Bangalore price, viz., annas 3 per lb., there is a sum of Rs. 74-10-0

The amount of rice bran consumed by the 6 cows in group I for the 5 weeks amounted to 630 lb. The price paid for this bran was Rs. 4-0-0 per 130 lb. therefore the 630 lb. cost Rs. 20-9-0.

From the above it can be concluded that by feeding this extra 3 lb. rice bran, a profit of Rs. 54-1-0 was made and this works out approximately at Rs. 9 per cow for 5 weeks, that is Rs. 1-12-0 per week or 4 annas per day.

Group II gained 290 lb. and group 1, 220 lb. in body weight in the 5 weeks, but I think this can be discarded as some cows put more flesh on than others.

As paddy is grown extensively in this Presidency it behoves the ryot to use this bran, which can be purchased at all local markets and mills for feeding this breeding stock as it is a good food where milk is required.

EXPERIMENT II.

The following experiment was tried in order to see if by substituting 20 lb. of green fodder (Rhodes grass) in a cow's ration by 12 lb. silage, made of maize and cholam, any increase or decrease in milk yields was noticeable.

It may be worth while mentioning here that silage is only green fodder crops (such as maize and cholam, etc.,) cut whilst they are green and stored in pits which must be dry, the fodder is either chaffed or put in long; it is pressed down by weights or by bullocks trampling it in order to squeeze out all the air and so make one large compressed mass. This silage can be used for feeding the cattle when grazing is scanty and when there are no green fodder crops growing, it comes fresh out of the pit and dairy cattle relish it very much when once they have accustomed themselves to it. Silage is an excellent fodder for India.

This experiment was conducted at Bangalore with cross-bred cows and lasted two months. The cows were milked three times a day at 2 a.m, 8 a.m. and 2 p.m. As before, animals (5 in each group) were selected and efforts made to procure cows about the same weight, the same number o days in milk and which yielded about the same amount of milk.

The rations fed to the animals consisted of—

*	*Group I.* lb.	*Group II.* lb.
Mixture	7	7
Groundnut cake	3	3
Brewers' grain, wet	12	12
Salt	2 oz.	2 oz.
Silage	12	20
Hay	Unlimited	Unlimited

* The mixture was made up of—

Bran
Cotton seed meal
Rice meal

Hay is put in racks in the paddocks and the cows are allowed to eat as much as they want. The milk was weighed and tested each day and records kept. The cows were each weighed before the commencement of the scheme and at the end of each week and their weights noted.

Group I.

Number of cow	Date of birth	Daily milk yield	Weight	Number of days in milk at commencement	Number of calves	Date of service
		Lb.	Lb.			
893	14- 3-18	23	780	9	2	25- 9-22
818	18- 4-17	23	700	101	3	8- 7-22
792	9-11-16	29	760	16	4	5-10-22
961	25-11-18	30	830	91	1	3- 8-22
495	25 -7-15	32	970	61	4	2- 8-22
	—	137	4,040	278	—	—

Group II.

967	21- 1-19	26	720	9	2	16-8-22
207	14- 2-19	23	760	101	1	8-7-22
888	27- 2-18	29	800	19	2	17-9-22
426	20-11-14	27	990	90	5	19-9-22
821	1- 5-17	29	780	58	3	15-7-22
	—	134	4,050	277	—	—

WEIGHT OF COWS.

Group I.

Number	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	9th week
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
893	746	746	782	794	752	760	804	780	760
818	716	706	717	734	676	680	734	728	746
792	716	708	719	750	720	680	736	728	720
961	840	842	848	854	824	825	844	840	840
495	1,012	1004	1,020	1,030	990	1,000	1,046	988	1,020
	4,030	4,006	4,086	4,162	3,962	3,945	4,164	4,064	4,086

Group II.

967	740	742	770	756	746	744	780	752	740
207	802	816	800	830	810	820	850	832	836
888	828	846	856	860	904	836	876	860	880
426	972	1,006	920	1,034	980	972	1,004	960	980
821	780	800	796	830	746	750	824	892	746
	4,122	4,210	4,142	4,310	4,186	4,122	4,334	4,296	4,182

Weekly Yields of Milk in Lb. per Cow.

Group I.

No. of cow	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	9th week
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
893	163	175	180	174	170	170	167	166	170
818	158	157	149	146	149	147	145	136	143
792	205	202	194	199	191	182	175	168	171
961	208	210	212	208	200	194	203	201	200
495	215	206	204	197	192	189	187	166	178
	949	950	939	924	902	882	877	837	862
Fat per cent.	M. E. 3·5 5·2	M. E. 3·4 5·3	M. E. 3·4 4·8	M. E. 3·4 5·0	M. E. 3·3 5·2	M. E. 3·4 5·0	M. E. 3·6 5·0	M. E. 3·2 5·0	M. E. 3·5 5·2

Group II.

967	175	175	173	175	172	163	159	155	161
207	16 /	168	166	163	156	147	146	146	149
888	195	197	194	186	192	187	183	173	180
426	195	188	190	189	181	175	176	164*	174
821	191	183	179	181	177	148*	142	145	142
	917	911	902	894	878	820	806	783	806
Fat per cent.	M. E. 3·4 8·5	M. E. 3·2 5·8	M. E. 3·3 5·1	M. E. 3·4 5·1	M. E. 3·4 5·4	M. E. 3·5 5·4	M. E. 3·6 5·1	M. E. 3·4 5·4	M. E. 3·6 5·6

The experiment has not given us very much information. Cow No. 821 fell sick during the sixth week of the experiment and never quite regained its normal yield. Cow No. 426 was sick during the last week of the experiment also.

The average daily Milk-yields of the two groups up to the end of the fifth week does not show much difference, as Group I commenced with a total daily yield of 137 lb. and Group II, 134 lb. at the end of the fifth week. Group I. yielded 126 lb. and Group II, 122 lb., whereas at the end of the experiment Group I, yielded 117 lb. and Group II, 108 lb.

The weights of the animals at the commencement of the experiment and at the end of it, do not show very much difference.

The only conclusion one can come to from the above experiment is that 6 lb.silage is equal to about 10 lb. of green grass (Rhodes) for feeding to Dairy Cattle.

EXPERIMENT III.

The Milkmen of Madras have a great prejudice against groundnut cake as a food for milch cow; so the following experiment was conducted at Bangalore to determine the feeding value of three different kinds of cake, viz., groundnut cake, linseed cake and gingelly cake.

2. Three groups of 5 cows each were selected and were arranged in groups as near as possible to relate to daily yield, days in milk and body weight.

3. The rations were mixed for each group and labelled separately. Each group had 42 bags of rations, each containing 55 lb. of concentrates, the brewers' grain being issued fresh daily. The same men milked the cattle throughout.

4. During the 6th week one of the cattle, No. 209— A in Group 1—fell sick so that it would be as well to take results up to the end of the fifth week:—

All the cows were milked 3 times a day, their milk was weighed daily and the milk tested for fat.

The rations fed to the cows consisted of—

	Group I.	Group II.	Group III.
	Lb.	Lb.	Lb.
Linseed cake	2	—	—
Groundnut cake	—	2	—
Gingelly cake	—	—	2
Rice Meal	2	2	2
Cotton seed hulls	2	2	2
Wheat Bran	3	3	3
Cotton seed hulls	1	1	1
Gram	1	1	1
Brewers' grain	12	12	12
Hay	10	10	10
Silage	25	25	25

Particulars of the Cows,
Group I.

No. of cow	Date of birth	Daily milk yield before experiment commenced	Weight	No. of days in milk	Date of service	No. of calves it had till it came into experiment
		Lb.	Lb.			
457	6- 4-15	27	1,016	103	29- 6-21	4
898	19- 3-18	24	800	120	6- 7-21	2
967	21- 9-19	22	700	27	30- 9-21	1
862	24- 9-17	26	876	117	20- 5-21	2
209-A	17- 3-19	23	556	69	—	1
	Total	122	3,948	436	—	—
		Group II.				
478	22- 6-15	26	916	103	14- 7-21	3
301	12- 3-12	24	876	78	16- 9-21	6
865	7-10-17	22	636	122	19- 6-21	2
904	23- 3-18	31	840	42	5- 9-21	2
972	24- 1-19	21	684	94	12- 8-21	1
	Total	124	3,952	439	—	—

Group III.

495	25- 7-15	25	988	110	14- 8-21	3
888	27- 2-18	26	812	51	24- 9-21	1
870	25-10-17	21	758	133	2-10-21	2
500	28- 9-15	30	936	118	1- 7-21	3
77-A	15-10-17	21	780	27	—	1
	Total	123	4,274	439	—	—

Weight of Cows Showing the Increase or Decrease During Experiment.

Group I.

No. of Cow.	Weight at commencement of experiment	Weight at end of experiment	Increase or decrease	Remarks.
	Lb.	Lb.	Lb.	
457	1,016	1,040	+24	
898	800	840	+40	
967	700	730	+30	
862	876	906	+30	
209-A	556	520	-36	Fell sick
			+88	

Group II.

478	916	880	-36	
301	876	905	+30	
865	636	641	+12	
904	840	882	+42	
972	684	728	+42	
			+90	

Group III.

495	988	1,006	+18	
888	812	828	+16	
870	758	786	+28	
500	936	968	+32	
77-A	780	806	+26	
			+120	

WEEKLY YIELD OF MILK.

Group I.

No. of cow	1st week	2nd week	3rd week	4th week	5th week	6th week	Total
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	
457	188	179	174	173	166	160	1,040
898	173	178	170	165	162	159	1,007
967	155	155	158	157	152	147	924
862	184	179	163	164	149	154	993
209-A	166	152	145	129	125	71	788
Total	866	843	810	788	754	691	4,752
Fat per cent.	M. E. 3·6 5·3	M. E. 4·0 5·5	M. E. 3·6 5·4	M. E. 3·8 5·2	M. E. 3·8 5·5	M. E. 3·7 5·6	

Group II.

478	180	171	160	160	146	153	970
301	168	161	162	154	149	149	943
865	151	148	147	142	128	139	855
904	221	213	208	198	203	201	1,244
972	144	145	186	144	149	147	915
Total	864	838	863	798	775	789	4,927
Fat per cent.	M. E. 3·5 5·5	M. E. 3·6 5·4	M. E. 3·6 5·4	M. E. 3·7 5·2	M. E. 3·8 5·4	M. E. 3·8 5·4	

Group III.

495	169	163	162	160	160	161	975
888	173	167	169	167	160	160	996
870	155	149	151	155	150	154	914
500	203	203	203	193	191	188	1,191
77-A	152	153	143	162	160	157	927
Total	852	828	828	837	821	820	4,993
Fat per cent.	M. E. 3·8 5·7	M. E. 3·9 5·5	M. E. 3·5 5·3	M. E. 3·6 5·2	M. E. 3·6 5·4	M. E. 3·7 5·6	

From the results obtained it will be seen that Group No. III did better than either Groups I and II in the yield of milk and also the weight of the animals, but when the price of this cake is compared with the price of groundnut cake fed to Group II cows it will be seen that it is much more economical as gingelly cake costs Rs. 8-5-4 per 100 lb. at Bangalore and Rs. 6-10-0 at Madras and groundnut cake costs Rs. 4-7-6 per 100 lb. at Bangalore and Madras.

After this experiment I should advise milkmen to feed ground-nut cake instead of gingelly cake as it is a great saving.

The superstition of the Madras milkmen that groundnut cake is not as good as gingelly cake for feeding milk cows is not well founded as the amount of milk yielded by feeding gingelly cake does not cover the extra cost of it.

			Rs.	A.	P.
Cost of feeding the cake—		Gingelly	29	2	8
,, ,, ,, ,, ,,		Groundnut	15	10	3
,, ,, ,, ,, ,,		Linseed	23	5	11
Value of extra Milk	88 lb.	Group I	16	8	0
Do	90	II	16	14	0
Do	120	III	22	8	0

MADRAS AGRIC. YEAR BOOK, 1923.

PESTS AND DISEASES.

CEYLON ENTOMOLOGY.

The following extract is taken from the Progress Report of Government Entomologist for the 1st Quarter, 1924:—

The following are some of the more important pests concerning which enquiries have been made during the period under review.

TEA.

Termites (*Calotermes* spp.) continue to be some of the more important pests of tea at various elevations. An unofficial experiment with Carbon bisulphide against *C. militaris* on an up-country estate has indicated that this fumigant may have a fatal effect on some bushes, but there appears to be no indication that these bushes may not have died from some other cause. It is also reported that bushes treated some three years ago on the same estate have been attacked again. This may mean that the termites were not entirely killed out at that time or that a re-infestation has occurred. It can hardly be expected, however, that Carbon bisulphide will have any permanent effect in preventing re-infestation of tea bushes.

At the suggestion of the Acting Entomologist, experiments are being made with explosives to destroy the nests of the mound-building termites on an up-country estate.

Green bug (*Coccus viridis*) was reported to be prevalent on an estate in the Haputale district. The Acting Entomologist visited the estate early in February and submitted a full report on the subject.

Tortrix (*Homona coffearia*) has been prevalent on some estates.

An outbreak of the lobster caterpillar (*Staurofus alternus*) was reported from one estate.

The caterpillars of *Prodenia litura*, a pest of many cultivated plants, were reported to be eating tea leaves on one estate. No serious damage appears to have been done, since the Superintendent stated that the caterpillars got on the young shoots of tea and died there. The cause of death appears to have been a "wilt" disease.

COCONUTS.

The caterpillar (*Nephantis serinopa*) is still present to a slight extent on a group of estates in the Polgahawela district. The Assistant in Entomology visited the estates and reported that all of them except one had taken or were taking measures to control the pest. His report has been submitted.

CACAO.

A specimen of the Red Borer (*Zeuzera coffeæ*) was forwarded with a portion of the cacao branch in which it had been boring. This is the first record which we have had of this insect attacking cacao.

VEGETABLE CROPS.

The Assistant in Entomology has continued the investigation of some pests of vegetable crops on the plots near the Laboratory, and visits have been paid to the Farm School plots and those of the Economic Botanist at Gannoruwa for purpose of investigations.

Special attention has been paid to the pests of Snake gourd (*Trichosanthes anguina*) and Bitter gourd (*Momordica charantia*).

Snake Gourd—Both the larvæ and adults of the beetle *Epilachna dode castigma* damage the leaves, while in the case of the beetle *Aulacophora* sp the adults feed on the leaves and deposit their eggs in the soil close to the main stem of the creeper. The grubs feed on the roots and lower portion of the stem. The bionomics of these beetles are being worked out and drawings of the stages are being made by the draughtsman.

The caterpillars of *Plusia* sp. and *Margaronia indica* have been observed attacking the leaves. They are partially controlled by small hymenopterous parasites. A caterpillar borer (*Sesiidæ*) has also been found.

Bitter Gourd—is attacked by *Epilachna 28-punctata* and *Xenarthra cervicornis*, both leaf-eating beetles. Fruit flies (*Chætodacus* spp.) have recently begun to attack the gourds, and poison baits are to be tried.

COTTON.

The cotton leaf-folder (*Sylepta derogata*) was reported from the Balangoda district, and the lobster caterpillar (*Stauropus alternus*) was sent in from Nalanda Experiment Station. This is the first record we have had of this insect attacking cotton.

A SUCCESSFUL ATTACK ON CUTWORMS.

H. G. WHITE.

Superintendent, Narara Viticultural Nursery.

Throughout the district of Gosford cutworms were very bad about the middle of October. Considerable damage was done to plants, particularly tomatos, many growers having to make several plantings before obtaining a good stand.

Throughout this nursery and vineyard they were also very numerous and at one time we were finding fifty and more cutworms round each vine. This was in ground that had not been cultivated until late in the season. Where the land had been cultivated and kept free from weeds and rubbish it was also fairly free from cutworms. The block of vines where the cutworms were so numerous was taken in hand immediately and sprayed with arsenate of lead. The following evening a poison bait, made of 1 lb. Paris Green, 24 lb. bran and 9 quarts water in which 9 ounces of salt had been previously dissolved, was laid.

Another section was treated with the poison bait only. Not many dead worms were found the following morning, but on the second day fully 80 per cent. of the cutworms round each vine were dead. The vines sprayed with the arsenate of lead showed no better results than those that received the poison bait only, so the spraying was not repeated. On the third evening a fresh supply of poison bait was laid. The following morning the remaining cutworms appeared listless and towards evening all were apparently dead. Nine days after application the bed was apparently free from cutworms.—AGRIC. GAZ. OF N.S.W., VOL. XXXV. PT. I.

CEYLON AGRICULTURE.

ALAWATUGODA SUNDAY MARKET SHOW.

W. MOLEGODE,

Agricultural Instructor.

The Alawatugoda Sunday Market Show was held on Sunday, 6th April, 1924, and opened by the HON. MR. W. L. KINDERSLEY, Government Agent, at 2-30 p.m., when he addressed the gathering at length on the need to grow food crops.

The object of the Show was to popularise the Sunday Market which was established on 29th July last year to answer the needs of the village producer of Udagampaha Korale in Harispattu. Ever since, on Sundays the villager brings his garden produce and articles of village industries such as pots and pans, knives and katties, mats and baskets, etc., which find ready buyers among traders and estate coolies.

On the day of the Show 60 people brought things and there were in all 174 lots representing vegetables, fruits, curry-stuffs, yams, village rice, kurakkan, coconuts, arecanut, plantains, knives and katties, mats, brooms and locally made washing soap. Nothing was specially prepared for the Show. Everything that was brought was ordinary marketing stuff. A committee of judges consisting of Messrs. A. N. Hutt, G. G. Auchinleck, C. E. Hamilton, H. Nugawela and W. Molegode marked out articles for awards. Mr. W. A. Udugama, Ratemahatmaya, Matale South, who was present, kindly assisted the judges. The list of awards is given below.

Cash for prizes were provided by the Department of Agriculture, the Hon. Mr. W. L. Kindersley, Mr. C. E. Hamilton, Mr. G. G. Auchinleck, Nugawela Ratemahatmaya, Mr. J. R. Nugawela and Mr. W. Molegode.

The presence of the Government Agent and of the Assistant Government Agent and other officials at the Show greatly encouraged the people and it is to be hoped that, now this Market is growing, a better site will be provided at an early date. For the present it is held on the grounds of the Circuit Bungalow which is far too small for the purpose.

List of Awards.

1. Collection of Vegetables ...	1st prize, Rs. 12·00	P. R. Amarakoon
...	2nd ,, ,, 8·00	M. Kirihamy
...	3rd ,, ,, 5·00	E. Dingawa
2. Cooly Garden Vegetables...	Rs. 10·00,	Achchu of Syston
3. Collection of fruits ...	Rs. 7·50,	P. R. Amarakoon
4. Plantains, Honderawala ...	Rs. 2·50,	R. Punchi Banda
,, Anamalu ...	Rs. 2·50,	K. Mudalihamy
5. Green Chillies ...	Rs. 2·50,	P. Siribadde
6. Heen Miris ...	Rs. 2·50,	W. T. Kuda Banda
7. Ginger ...	Rs. 2·50,	K. Appuhamy
8. Dry Turmeric ...	Rs. 2·50,	W. T. Kuda Banda
9. Country Rice ...	Rs. 5·00,	A. R. Amarakoon
,, ...	Rs. 2·50,	T. B. Ratnayake
10. Kurakkan ...	Rs. 2·50,	K. Kiri Banda
11. Home Garden Produce, 1st	Rs. 5·00,	L. B. Werekoon, Alawatugoda School

Home garden produce	2nd	Rs. 3·00, S. Panditharatna, Alawatugoda School
	3rd	Rs. 2·50, M. B. Ratnayake, Ankumbura School
12. Village Poultry	...	Rs. 5·00, R. M. Punchi Banda
13. Goats	...	Rs. 7·50, N. D. Perera
,,	...	Rs. 2·50, Karuppen
	Special Prizes.	
14. Brinjals	...	Rs. 2 50, P. Siribedde
15. Ash Plantains	...	Rs. 2·50, D. Punchirala
16. Locally made Soap	...	Rs. 2·50, N. Noor Deen

PADDY CULTIVATION COMPETITIONS IN KEGALLE DISTRICT, MAHA SEASON 1923-24

The following prizes for the best cultivated area of paddy in the Maha Season of 1923-24 were allocated by the Department of Agriculture —

		1st. Prize	*2nd. Prize*
Beligal Korale	...	Rs. 30	Rs. 20
Galboda-Kinigoda Korale	...	,, 30	,, 20
Paranakuru Korale	...	,, 30	,, 20

The object of these competitions is to encourage better methods of cultivation, manuring, transplanting, etc.

These competitions were organized by the District Agricultural Committee and worked through the headmen and the Cultivators' Improvement Societies.

The prizes as will be seen are attractive as compared with previous years and hence keenness was displayed by the cultivators in their methods of cultivation.

Inspections were made at various stages of growth and the principal points judged were methods of cultivation, cleanliness of surroundings, manuring, seed rate, etc.

Beligal Korale.—Fifty-three competitors entered for competition and the judges MR. P. C. DEDIGAMA Ratemahatmaya and MR. C. P. CRISPEYN, Agricultural Instructor, recommended the two following competitors for the prizes :—

1st Prize.—Ratukankanamalage Punchi Appuhamy of Ampe

2nd Prize.—Dissanayaka Mudianselage Punchi Banda of Bambaragama

Galboda-Kinigoda Korale.—Forty-six competitors entered for competition. The Judges MR. C. L. RATWATTE Ratemahatmaya and MR. C. P. CRISPEYN, Agricultural Instructor, recommended the two following competitors for the prizes.

1st. Prize.—W. M. D. Banda, of Ussapitiya

2nd. Prize.—H. Mudianse of Batambura

Paranakuru Korale.—Forty competitors entered for competition and MR. M. B. MAPITIGAMA Ratemahatmaya and MR. C. P. CRISPEYN, Agricultural Instructor, recommended the two following competitors for the prizes.—

1st. Prize.—N. U. Arachchi of Rahala

2nd. Prize—D. P. P. Weerasinha of Hatgampola

AGRICULTURAL EDUCATION.

SCHOOL OF AGRICULTURE, PERADENIYA.

PRIZE DAY: SATURDAY, MARCH 29, 1924.

The annual prize distribution of the School of Agriculture took place on Saturday afternoon March 29th at the School Hall. SIR ANTON BERTRAM, Chief Justice, presided, and others accommodated with him were : Lady Bertram, the Hon. Mr. W. L. Kindersley, the Hon. Mr. F. A. Stockdale (Principal), Mr. G. G. Auchinleck, Divisional Agricultural Officer, Central, and Mr. J. C. Drieberg (Farm School Officer).

MR. STOCKDALE read the following report :

THE REPORT.

The prize-givings of this School have usually been held in the latter half of the year but it has been thought advisable that they should in future follow immediately after the Final examination. The awards and certificates will therefore be distributed to those Students who have just completed their second year's course, whilst medals and certificates will be awarded to the Teachers of Vernacular Schools who have had a special course of training for one year.

The number of students in the School in the English Class is 27—15 second year students who have just completed their course and 12 first year students. In addition there are 12 teachers from Government Vernacular Schools for the special one year's course in the vernacular. For the next course 20 students have been selected from the 34 applicants. Two of the students for the next course are coming from the Northern Shan States in Burma having been specially selected by the Superintendent of these States who desires that they should receive special training in the cultivation and manufacture of tea.

The work of the school has been under the supervision of the Divisional Agricultural Officer Central, and the various lectures and field work have been carried out under the instruction of Mr. J. C. DRIEBERG, Farm School Officer, Mr. JAYASUNDERA an old student of the School and Mr. WICKREMASEKERA until 15th June last and subsequently Mr. JANSZ, another old student of the School. Special lectures have also been given by Mr. AUCHINLECK, Mr. PETCH and Mr. JOACHIM and by officers of the Entomological, Mycological and Economic Botany division of the Department, and special attention is given to the field cultivation of paddy, tea, rubber, cacaó and coconuts and to the growing of various food crops on those plots which are worked by the students themselves. A beginning has been made with Poultry-keeping and the results so far obtained have been encouraging. Bee-keeping has not made as much progress as I could have hoped for, but some students have shown a keen interest in this work. The establishment of a small instructional dairy is being undertaken. Specially selected Scind

cattle have been secured from India and are housed temporarily on the Experiment Station pending the completion of the buildings which have been promised by the Public Works Department for May next. It is intended to run this dairy on commercial lines and to give students at the School practical experience in animal husbandry and especially in the feeding and handling of cattle.

The further extension of the practical training for students of this School has been made possible by the offer by GATE MUDALIYAR A. E. RAJAPAKSE of special training to passed students of the School in coconut cultivation upon his estate at Puttalam. One student has already passed through this special course and two others are at present on the estate. The thanks of the School are due to MUDALIYAR RAJAPAKSE for this practical assistance and it is hoped that other estate owners will come forward with further offers of training in actual estate work for the passed students of the School.

A new line of work undertaken by the students in the last term has been the study of agricultural economics in a village near to Peradeniya. Periodic visits were made to the village in the company of a member of the Staff with the object of obtaining first-hand information regarding the economic condition of the inhabitants and the state of the agriculture of the village. This work has been inspected by the Director of Statistics and he was pleased with the type of enquiry carried out and the interest shown therein by the Students.

The instruction in the School has been modified somewhat in the past two years so as to bring the Students into the closest possible touch with the practical side of agriculture. Students are now being required to do a greater amount of actual work in the field and to undertake in their second year definite works of responsibility. The examination results this year have not been up to the usual standard in Chemistry and Botany. Two first classes have been awarded and one second class, 5 pass certificates and 6 partial certificates. Those students who come to the School with good educational qualifications have maintained the examination standards of previous years, whilst the others with lower educational qualifications have been unable to do so. All students are however leaving the School better equipped in practical agriculture than students did formerly.

The annual tour of the School took place early in January in Colombo and Negombo, and the places of agricultural interest visited were—the Manure Works of A. Baur and The Commercial Co., the Government Dairy, Sir H. M. Fernando's Farm at Mattacooly, The Wester Seaton Dairy at Negombo, the Alexandra Coconut Trial Grounds, Mr. J. D Vander Straaten's Fibre and Desiccating Mills, Messrs. Seneviratne's Oil Mill; Palugaswewa Estate, Puttalam; The Sewage Treatment Works, The Colombo Gas Works, The Ice and Cold Storage Co., The Observatory, The Spinning & Weaving Mills and the Hewavitarne Weaving School. The best thanks of the School are tendered to the respective proprietors and managers of these establishments, for their courtesy in receiving the students and taking them over the works. In every case the visit was of both interest and profit to the Students. While in Negombo the students were the guests of Gate Mudaliyar RAJAPAKSE and of Mr. J. E. P. RAJAPAKSE, to whom the School tenders its grateful thanks.

There has been a demand in some quarters that this School should do work of a much higher standard even up to University standard. This would not be possible except by students with educational qualifications up to Matriculation standard. Such demands have been made by persons who have a complete misconception of the objects of this Farm School at Peradeniya and of the school which will be opened next year for the Tamil

districts at Jaffna. These schools are designed for an essentially practical training in agriculture and the sciences that underlie agriculture. They aim at providing the sons of land-owners with a knowledge which will enable them to develop their lands and to deal with the various pests and diseases which affect their crops. An agricultural college of University status will undoubtedly have to be established in Ceylon as an institution affiliated to the University of Colombo, but such an institution will require a staff of specialists which will equal in number that staff provided for the Imperial College of Agriculture in the West Indies where there are 7 Professors in addition to Lecturers and Demonstrators. The Peradeniya School was always intended as a middle school of agriculture and has been designed on lines which have been successful in other countries in providing a practical training for the sons of agriculturists. It does not aim at a University Standard.

The training of the teachers from the Government Vernacular Schools has been under the charge of Mr. C. WICKREMARATNE. The examination results have been good and the work of these teachers throughout the whole of their course has been excellent. Their practical work on plots has been very good throughout. Those teachers who had previously passed through the Training College, Colombo, have made the most progress and observation lessons on Agricultural subjects have shown clearly the value of this earlier training.

The School tenders its thanks to the donors of prizes, by the offer of which they show their appreciation of the work being done here; and at the same time encourage the work of students. His Excellency the Governor has again given his prize for general efficiency in Practical Agriculture; and Gate Mudaliyar A. E. Rajapakse continues to offer the gold medal for the best all-round student of the course. The other gentlemen who have kindly given prizes are: Sir Solomon Dias Bandaranaike, Sir H. Marcus Fernando, the Hon. Mr. H. L. De Mel, Mudaliyar V. M. Muttukumaru, Mr. C. E. A. Dias, Mr. J. C. Ratwatte Dissawe, and Mr. Elapata Dissawe, Mr. W. A. de Silva, Mr. Graham Panditteseker and Muhandiram N. Wickremaratne.

The staff of the School has put in hard work during the year and I desire to make here special reference to it. I cannot close without a reference to the loss which the Department of Agriculture and this School have incurred by the death of Mr. H. L. Van Buuren. Mr. Van Buuren was a lecturer at the School until he was selected for more responsible work in the division of Economic Botany. He throughout took a keen interest in the work of the School, and the Colony has lost a promising agricultural officer by his death.

The Governor's Prize goes to Mr. M. S. Bandara who had been selected by Richmond College, Galle, for this special agricultural training and who returns to Richmond to start the teaching of agriculture in that College. The Rajapakse Gold Medal is awarded to Mr. C. St. J. C. Pereira who has done well in all subjects.

We welcome, you, Sir, again to our prize-giving. This is the third occasion on which you have visited the School. It was opened by you in 1916 and I think you will note the progress that has been made since that year in the equipment of the School. I regret that MRS KINDERSLEY is prevented by illness from giving away the Prizes and Certificates on this occasion but LADY BERTRAM has graciously consented to do so.

F. A. STOCKDALE,

Principal.

The Chairman then called upon LADY BERTRAM to give away the prizes and certificates. The following is the list:

AWARDS.

MEDALS.

"The Rajapakse Gold Medal," for the best all-round student of the course, presented by Gate Mudaliyar A. E. Rajapakse, J. P., awarded to C. St. J. C. Pereira.

PRIZES.

His Excellency the Governor's Prize, presented for general efficiency in Practical Agriculture, awarded to M. S. Bandara.

For Agriculture :—

1st Prize presented by Sir Solomon Dias Bandaranaike. Kt., awarded to W. B. Mahagedara.

2nd Prize presented by Muhandiram N. Wickramaratne, awarded to M. S. Bandara.

For Agricultural Chemistry :—

1st Prize presented by C. E. A. Dias, Esq., awarded to C. St. J. C. Pereira.

2nd Prize presented by E. A. Elapata, Dissawe, awarded to M. S. Bandara.

For Agricultural Botany :—

1st Prize presented by Mudaliyar V. M. Muttukumaru, awarded to S. Dharmarajah.

2nd Prize presented by J. C. Ratwatte, Dissawe, awarded to D. Seneviratne.

For Agricultural Zoology :—

1st Prize presented by the Hon. Sir H. Marcus Fernando, awarded to C. St. J. C. Pereira.

2nd Prize presented by Dr. W. A. de Silva, awarded to D. Seneviratne.

For Economic Products :—

1st Prize presented by Hon. Mr. H. L. De Mel, C.B.E., awarded to W. B. Mahagedara.

2nd Prize presented by Graham Panditteseakere, Esq., awarded to S. Dharmarajah.

CERTIFICATES.

Class 1.—Cramer St. John Collette Pereira, W. B. Mahagedara.

Class 2.—Mendis Samuel Bandara.

Pass.—Subramaniam Dharmarajah; Alfred Frederick Goonewardene; Frederick Arthur Jayawardene; Seenithamby Nalla Ratnam, Dewawansa Seneviratne; Clarence Emmanuel Llewellyn de Silva; J. S. Tilton de Silva; Walter Peiris Goonetilleke; Joseph Adolphus Berkman Mackelvie; Edward Herbert Perera; Percy Hamlyn Rambukpotha.

AWARDS OF CERTIFICATES TO TEACHERS.

Silver Medal	...	R. B. Herath
Bronze Medal	...	D. A. Edirisinghe
do	...	C. A. Perera

CERTIFICATES.

L. D. Abraham; K. D. Charles; U. B. Dissanayake; D. A. Edirisinghe; D. C. S. Jayasekera; P. B. Herath; R. B. Herath; M. Mudiyanse; C. A. Perera; D. J. Rajapakse; H. K. Ratranhamy; W. A. Wanasinghe.

THE CHAIRMAN'S SPEECH.

SIR ANTON BERTRAM said : Ladies and Gentlemen, I should like in the first place most warmly to congratulate the winners of prizes and certificates. As one saw them coming up to receive their honours, one felt that they were a set of young men of whom any country might be proud. It is very interesting to see that their number includes those who are going to be responsible for village education throughout the country. I don't suppose there is any more important responsibility. I congratulate the young men who have adopted the profession of agriculture. It is one of the professions most worthy of a gentleman and always has been, throughout the history of the world, and I think, too, that it is one of the most fruitful avenues to a happy life. In my younger days I was in the chambers of LORD LOREBURN, the great LORD CHANCELLOR, then SIR ROBERT REID. I always remember a saying of his. When we had done our afternoon's work, he would sometimes tell me the inner secrets of politics or talk about other general subjects but one day he said to me, "I will tell you something—I will tell you my inner creed. This is my advice to you; do something to relate yourself to the earth, whether it be even tending a flower-garden, do something to bring yourself into contact with Mother Earth. That is my philosophy of life. That is one of the real roads to happiness." These were somewhat mystical observations to come from a great and busy lawyer, but I believe that there is a great philosophical truth in them. I believe you young men who have chosen this profession will have your reward. I always come to Peradeniya with pleasure and this is the third prize-giving I have attended. The whole place is so full of beauty that to come here is to be inspired. I recollect the last time I was in Kandy one day returning from Matale and seeing on the roadside, I forget which road, a village school. And the schoolmaster there was obviously a man of enterprise. His school was on the top of a slope. It was turned into a trim lawn. On the top there grew a row of dræcenas and on the space below he had inscribed by means of white stones an inscription in both languages, English and Sinhalese. These were the words of the inscription : "Agriculture, Mother of the State." I hope during these sessions to go and visit the school of that excellent schoolmaster. I hope he is still there and that his inscription remains.

Well, as I say, one comes here and feels inspired by the beauty of these surroundings, and one is tempted to indulge in general and eloquent observations. But I think we have been duly warned in the columns of the Press in recent days that this question of agriculture is one which requires something more than mere enthusiasm. It requires something in the way of real deliberate thinking. We speak of agriculture as an occupation to which our young men should come. I myself have compared it with the legal profession to the advantage of agriculture. Well, as I have said, this is a matter which requires a certain amount of thinking. We are always advising people to go back to the land and devote themselves to the land.

There is no finer class of men in the world than the class of country gentlemen. In the history of England the country gentleman has been one of the greatest and most important elements. There is no more important class than that and I hope myself that this is a class which will more and more develop in Ceylon, but it is limited to those who are blessed with paternal acres. But for the great body of young men of this country, what is their outlook ? They cannot all live on their paternal acres. The paternal estate gets divided generation after generation, and, when a father reflects "to what career shall I send my boy," what is the position ? If the boy has great intellectual abilities, if he shows certain aptitude for study and has an active mind, his father may say "I will send him to law." If he has an interest in science, his father may say "I will make him a doctor." But what will be the position of a father whose boy delights in the open air ? Can the father say "I make him an agriculturist ? What career will be open to the boy under present conditions ?"

I think myself that it is the destiny of this school as it develops to provide an agricultural career for the young men of the soil. At present when we look on its numbers we must say that it is still in its infancy—a vigorous infancy, no doubt, but still in its infancy. I myself think that it should be possible for young men in Ceylon to look forward to earning their living in the profession of agriculture. At present, I think, the openings for them are very small. It has not been realised how valuable it would be for the successful conduct of agriculture to have a superintendent who has had a sound agricultural education, but I trust it will be more and more realised, and that young men of this country who wish to devote themselves to that career will find a sphere which will reward their energies and encourage their ambitions. I do hope that this school is destined to provide that, though, of course, it is not good to provide a supply unless there is a demand. But I do trust that the example of these young men we have seen to-day, when they take charge of posts in connection with estates, or perhaps estates themselves will make it clear that it is an advantage to have had a practical scientific training. I look forward to the development of the curriculum of the school. I look forward to the day when owners of large coconut estates or rubber estates or even tea estates, when they want an assistant superintendent or a superintendent will regard the school at Peradeniya as the natural place to go to find in an old boy of that institution the young man they consider most worth having. MR. STOCKDALE, in his highly interesting report—a report the interest of which can hardly be perhaps realised at the first reading—spoke of the coming college in connection with the University. I confess that he somewhat terrified me when he indicated that in order to make an effective agricultural college affiliated to the new University, you would require apparently as large a staff as the whole of the rest of the University, for all the other subjects combined. Well, this is a large demand, but I trust we are destined to have that college, whatever the cost. I imagine that the site of the college will be Peradeniya and not Colombo. It is quite possible to have a University composed of colleges in different parts of the country, but I imagine that the number of young men from Ceylon who will desire to devote themselves in that advanced manner to the scientific side of agriculture to obtain a University degree will be comparatively limited. I believe that even when we have that college, the real source—the principal source of education in agriculture—will be this school. It is something between a school and a University. It is a place for the training of practical agriculturists upon a scientific basis, and combining with that basis a real, practical, first-hand training. Whatever the future of the University this school is destined to progress and enlarge. I congratulate it on the progress it has made and I look forward to still greater progress, on a much larger scale in the future. May I say one word of friendly criticism? When I was last here I expressed the hope that the grounds of this school which looked bare at that time, would, as time went on, harmonise with the exquisite beauties of Peradeniya. Beauty is so easy to obtain in this wonderful climate; but I confess that on looking at them now they still wear a severely business-like air. Indeed, on walking through the gardens themselves the other day they seemed to wear an unwonted appearance and I wondered whether the blighting breath of retrenchment had breathed upon them. MR. STOCKDALE, however, assures me that this is a purely seasonal feature and that the lovely sight one is accustomed to catch from the Orchid House would charm us again in due course. May I once more congratulate the young men who have won prizes and express the hope that the training which they have received will lead to a life which is both efficient and happy.

THE HON. MR. F. A. STOCKDALE proposed the vote of thanks to SIR ANTON and LADY BERTRAM.

CO-OPERATION.

CO-OPERATION IN MYSORE.

MR. MIR HAMZA HUSSAIN, B.A., B.L. *

First Member of Council, Mysore State.

The movement in India is not essentially of popular growth in the sense that it is not due to any demand or desire on the part of the people for a new order of society. The teachings which led to the establishment of the co-operative movement in the West led also to the spread of socialism. In fact the creed of ROBERT OWEN was mixed up with socialism. In some continental countries co-operation is allied to socialism. In India we need entertain no such fear. There is no such class here as that of capitalists and no divergence therefore between capital and labour. Thanks to the caste system, it prevents the cleavage of society into what is called in the West the capitalists and labourites. Any caste, however numerous, will contain within its fold both these classes of persons who will necessarily come into social contact with one another. So far as the Mahommedans are concerned, the doctrine of social equality is so much ingrained in them on account of their religious teachings that there is no possibility of an exclusive class of landed proprietors or capitalists springing up.

The co-operative movement in India owes its origin, as you know, to the Co-operative Credit Societies Act, 1904, which was inspired first by the report of SIR FREDERICK NICHOLSON and subsequently by the Committee that was appointed by LORD CURZON under the presidency of SIR EDWARD LAW. The Act of 1904 has since been replaced by Act of 1915 which authorizes the establishment of non-credit societies and of Central and Provincial Banks. Though the movement in the present form is an exotic which was planted on the soil of India, it has taken firm root and has spread itself to all parts of India. There were at the end of the year 1921-22, 47,879 co-operative societies including Central Banks and Unions, with a membership of 2,983,534 and a working capital of Rs. 289,832,000 and they advanced loans to the extent of Rs. 161,149,710. This remarkable growth in the space of about 18 years is due partly to the exertions of the Co-operative Department which was created under the Act in almost all provinces of British India and chiefly to the fact that co-operation both as an idea and as a system of business was not unknown to India. There was an indigenous system of banking available to persons of small means called the Nidhi which corresponds in some respects to Provident Funds and Friendly Societies of European countries. There is besides the co-operative partnership system which is practised even to this day by the Marwadis and Labbe merchants under which an employee after some years of successful working becomes a partner of the business with

* Presidential Address delivered at the Mysore Co-operative Conference.

his employers. But the most important of all Indian co-operative institutions is the joint family system under which labour, capital and skill combine to manage a family business working under the accepted co-operative formula 'each for all and all for each.' PROFESSOR MARSHALL in his great work on Economics says: "The accumulation of capital is governed by a variety of causes, by custom, by habits of self-control and forecasting and realizing the future and above all by the power of family affection." It is this power of family affection which has given the Hindu society the power to resist the hordes of foreign invasions and keep the village community intact. Wherever the joint family system is in vogue, the family, whether it be of an agriculturist or of a merchant or trader, flourishes and its prosperity declines the moment the family becomes divided. But the present tendency of the Hindu society is plainly individualistic. As soon as a member of a joint Hindu family begins to earn, he separates himself and sets up an independent establishment of his own and this tendency has been greatly encouraged by our Civil Courts who go so far as to treat an unambiguous and unequivocal intention to separate, as equivalent to an actual partition. However, a co-operative society seems to be the only remedy against the evils of this individualistic system.

CO-OPERATION IN MYSORE.

Our State was the first in the field of co-operation in India. Whilst other provinces were still cogitating, the late SIR SESHADRI IYER conceived the idea of Agricultural Banks and started them in the year 1904. I shall deal with this subject later on, but I may state here that with the passing of the Act of 1904, we gave up our special institution and fell into line with British India. We passed a legislation, the Co-operative Societies Regulation of 1905, which, though somewhat different from the Indian Act of 1904, is mainly based on that model, and since the passing of the amended Regulation of 1918, our system is in complete accord with that obtaining in British India.

The progress that we have made in the field of co-operation cannot but be regarded as satisfactory. This is also the opinion of the Committee that sat under the presidency of the HON'BLE LALUBHAI SAMALDAS to examine the spread and working of the co-operative system in Mysore. There are in all now 1,539 societies with a total number of membership of 101,091 and a working capital of Rs. 8,695,108. The progress of the movement was slow and cautious during the first five years of its existence there being 111 societies at the end of the year 1910-11. During the subsequent quinquennium, the number rose to 800 and since then its progress has been steady. Having regard to the population and its area, our State, though, not the first or the second, occupies a leading place among the provinces in British India as is shown by the percentages noted below :—

Punjab	...	45·0
Central Provinces	...	35·7
Bombay	...	17·7
Madras	...	17·5
Bengal	...	14·4
Mysore	...	25·3

AGRICULTURAL CREDIT SOCIETIES.

Our societies may be divided into credit societies and non-credit societies and the former into agricultural and non-agricultural. Our societies as in British India are mostly of the agricultural credit type, there being as many as 1170 belonging to that class. Though the societies afford cheap capital to the agriculturist, they are wanting in the true spirit of co-operation since they are based on the share system and the shareholders, as you all know, are generally anxious to have a good dividend on the shares. Provision has been made to restrict this tendency, by providing that profits beyond a certain limit ought not to be distributed without the permission of the Registrar, but instances are not wanting where dividends have been distributed without any such permission. It is hoped that the Registrar will not hesitate to cancel the registration of such recalcitrant societies.

There is a great scope for the expansion of the system. There are 16,000 villages in the State. It is too much to expect that every village should have a society of its own, but giving one co-operative society for 3 villages, we must at least have 5,000 societies in the State of the kind under consideration. There is no doubt, that the paucity of workers in villages hampers the work of development but with the expansion of primary and middle school education, there should be no difficulty in reaching this goal in the course of a few years. There is a great need for the societies of cotton growers, paddy growers, ragi growers, potato growers, etc., who can purchase the produce from the ryots and sell it to the best advantage allowing the seller to share in the profits. There are a few societies of this kind but their number is insignificant. Formation of such societies will greatly increase the prosperity and well-being of the ryot.

I have not been able to find from published reports how many of our societies are in a moribund condition and how many of them have been allowed by the Department to remain in a state of suspended animation. My impression is that there are a good many societies which are not in working condition. The Registrar, I hope, will take steps to wind them up after giving them a chance to revive; for it is far better to have a small number of societies in an efficient condition than a large number of them in an indifferent condition.

NON-AGRICULTURAL CREDIT SOCIETIES.

It has been found difficult to draw a line between an agricultural credit society and a non-agricultural credit society, because the membership of these societies is a mixed one consisting of both the agriculturists and non-agriculturists. Taking such societies as have for their members a majority of non-agriculturists, the Mysore Committee on Co-operation compute the number of such societies at 263 with a membership of 4,296 and a share capital of Rs. 1,844,000. With regard to these societies, the Committee observe :—

"We may say generally of these societies that they form a strong and satisfactory side of the co-operative movement in the State. The members are, as a rule, literate and there is no difficulty in securing a proper managing committee. The funds raised by them being mostly local, considerable watch is kept by the members generally on the acts of the managing

committee and any serious irregularity or neglect on their part is immediately noted and steps taken to set matters right. These societies are exceptionally strong on the financial side. Scarcely any of them ever stand in need of financial assistance from the central institutions. They have secured public confidence and they are able to raise all the money they want by local deposits."

It is these societies that can solve many an economic and industrial problem of the State, as they are backed up by the intelligentia of the country. Having adequate capital at their command and an enlightened management alive to the needs of the times, these societies can very well follow the example of the wholesale societies of England and add a productive branch to their activities. These societies can, in addition to their ordinary business of credit, start a small industrial workshop, say, for the hulling of rice, for the manufacture of jaggery, ghee and oils, etc. It has been proposed that the reserve fund of these societies may be added on to the working capital and utilized in lending it to borrowers. But a better course would be to divert it for the purposes stated above. It is the productive side of our co-operation that requires development and we want more societies for the conversion of our produce into finished products.

NON-CREDIT SOCIETIES.

There are very few societies formed for the purpose of supplying purely the agricultural needs of the ryots. Out of 146 societies there are only 72 societies which are formed to supply manure, seeds to the ryots, but the amount of work they do is almost insignificant. We have adopted of late a combined system of credit and supply under which the ordinary credit societies purchase manure, seeds, etc., and supply them to the ryots. The Agricultural and Co-operative Departments are working hand in hand and as a result of their combined efforts we have already started 46 societies of this type and in course of time, we are sure that other agricultural co-operative societies will follow suit and enlarge the sphere of usefulness. Under this head also come the societies like the weavers' societies of craftsmen and artisans. There are in all 69 societies of this description of which 43 are weavers' societies. Of the latter the Bangalore Weavers' Society is the most important. It has a membership of 236, with a share capital of Rs. 12,742. The society did business to the extent of Rs. 139,571 during the year 1921-22 and was able to declare a dividend of 10 per cent. But the drawback in the constitution of the society is that it permits the sale of goods manufactured with the materials supplied by it to outsiders and this may land it in difficulties. The Mysore Co-operative Committee recommended the establishment of a central sale society to which all the primary weavers' societies should be affiliated. The suggestion is commendable and may be adopted. In fact the present weavers' society can be easily converted into an organization of this kind.

The Census Report shows that there are 34 castes in the Mysore State most of which are those of artisans and craftsmen and other manual labourers who live mostly in towns and big villages. There is plenty of scope for the formation of societies amongst them. For example, there should be a milkmen or gollars' society in almost every town for the supply of milk, a fuel society for the supply of fuel, a blacksmiths' society, a jewellers' society and so on. There is abundant material for this purpose and a rich harvest will be reaped if a little co-operative spirit is infused into the men.

SERICULTURAL SOCIETIES.

Next to agriculture, sericulture is the most important industry in the State, but it is a matter for regret that there are only 6 co-operative societies for the supply of disease-free eggs and implements for rearing cocoons, etc. working in the State. There is no object gained in having an exclusive society for the purpose. Just as in the case of agriculture a combined credit and supply society has been found to be useful; sericultural societies of the kind will be more popular and will relieve the ryot of the necessity of going to the sowcar to raise money for his ordinary needs.

GRAIN BANKS.

The necessity of grain banks to enable the ryot to tide over a season of distress is apparent, but there is no agreement as to the type of the society to be started. MR. ZAHIRUDDIN MECCI, who takes a keen interest in the formation of such banks, has elaborated a scheme under which each village is expected to form a bank of its own, each family in the village contributing a certain quantity of grain in the harvest season which will be loaned to the ryots in the time of need. The Mysore Co-operative Committee has examined this scheme as also the scheme of our late Registrar, MR. SHAMA RAO, and has recommended that the grain banks should be placed on a co-operative basis. This is the only possible alternative, but unless there is some provision made for the disposal of the surplus stored grain after the necessary reserve is formed, the society will be a charitable institution only and will not be able to attract grain deposits from well-to-do members who may not feel the necessity in time of distress to borrow grain from the bank. The matter may be discussed in this Conference and measures may be devised to place the scheme on a practical footing.

Talking of grain banks, I may refer to the necessity of consolidation of scattered holdings and it seems to me that having regard to the habits of ryots, co-operative farming will not be a success as it has been in Denmark. But I would like to see a co-operative farm being worked up. Government have been releasing a large extent of Amrut Mahal lands for cultivation. An estate can easily be carved out and worked on co-operative principles. It is for the intelligentia of the country to take up the scheme and work it to success.

CO-OPERATIVE STORES.

There are 80 stores in the State and many of them are run by credit societies. They are engaged in the supply of household provisions and cloths. They are to be found mostly in the towns and are patronized mostly by the official class who find in a store a useful credit house for the purchase of their daily necessities of life. The constitution of these Societies is based on the Rochdale system, with this difference—that the sales are not made invariably on a cash basis and price charged is not the market price. The Mysore Co-operative Committee who examined the question in great detail are in favour of allowing the present practice to continue. I would, however, like to draw the attention of this Conference to the Co-operative formula "credit for consumption is the road to poverty—credit for production is the road to well-being."

HOUSE-BUILDING SOCIETIES.

In England, house-building societies are generally brought under the co-operative movement. There is a separate Act called the House Building Societies Act, 1894, under which house building societies are registered. There is, however, a movement of very recent growth called the Tenants' Co-partnership System under which a society buys a piece of land, constructs a number of houses and lets them out to its members. There are very few societies of this description in England, but they have sprung up very rapidly and promise great extension and usefulness in future. We have 7 building' societies of which only 4 are active. These societies, with the exception of the Non-gazetted Officers' Association Co-operative Society,. are credit societies formed for advancing money for constructing houses for the supply of materials for the same purpose, and in one case only for buying of houses also. The Non-gazetted Officers' Association Co-operative Society is the only association that has acquired a piece of land, laid it out and constructed houses. The Mysore Co-operative Committee are strongly in favour of the Tenants' Co-partnership System, but advocate at the same time financial aid to the societies from State funds. Government have already sanctioned an advance of a sum of Rs. 10,000 for the Non-gazetted Officers' Association Co-operative Society and the general question of making a fixed allotment every year will, of course, be examined. But these societies, though they have been serving a useful purpose in enabling the members to secure houses of their own, cannot go far to relieve congestion in towns and cities or to solve the problem of housing the poor. These are matters that come within the purview of State or municipal socialism and need not be discussed here.

CENTRAL BANKS AND UNIONS.

In the financing of primary societies the central banks play an important part. In some provinces in British India there is an intermediate body called the Union, a federation of co-operative societies which undertake the duties of supervision of the primary societies, the investigation of their applications for loans, combined in some instances with a guarantee for the loans advanced to societies. Of the Unions which were started in Mysore, some did not start work, while others which started work did not prosper and three of them have, under the orders of Government, been converted into District Banks. Our State being a small one and there being a Government department for the investigation of loans the necessity for the existence of an intermediary is not apparent and the Mysore Co-operative Committee have rightly recommended, I think, the cancellation of the few existing Unions.

The financing of the primary societies is done now chiefly by the central banks. The Central Co-operative Bank and the Provincial Co-operative Bank are doing good work and are in a prosperous condition, the Central Bank having declared very recently a dividend of 10½ per cent. The Provincial Bank passed through a period of great stress very recently, but I am glad to state that with the assistance of the department it has tided over the crisis. There is some difference in the constitution of the two banks. The management in the Provincial Bank is largely in the hands of affiliated societies, whereas, in the Central Co-operative Bank it is in the

hands of individual members. There is also the difference that the Provincial Bank lends money to primary societies only, but the Central Bank lends money both to primary societies and to individuals. It is the latter aspect of the Central Bank's activities that has come in for adverse comment at the hands of the Mysore Co-operative Committee, as in actual working the bank has been advancing a large proportion of its loans to individuals. The Committee recommended the amalgamation of the two banks with a constitution similar to that of the Provincial Bank or in the alternative, alteration of the constitution of the Central Bank. The recommendation of the Committee will, I hope, receive full and adequate attention at the hands of the Central Bank.

AGRICULTURAL BANKS AND LAND MORTGAGE BANKS.

I have stated that Mysore was the first in the field of co-operation in India as it started agricultural banks in the year 1894. The constitution of these banks was on the approved Raffisen type, but they were all financed by the State. There were in all 61 banks started and a sum of Rs. 1,730,341 was advanced to them by the State. The coffee banks of Chickmagalur and Saklespur appropriated between them Rs. 975,915 and a sum of Rs. 459,211 has in all been recovered from them. The rest of the 59 banks received a sum of Rs. 753,426 and a sum of Rs. 731,418 has been recovered from them. It will thus be seen that the loss caused to Government from these latter banks is insignificant. It is the failure of the coffee banks that has brought the whole system into disrepute. Had the department not been discouraged by the failure of the coffee banks and worked up the remaining banks, the small sum of Rs. 22,000 which the Government have lost upon the latter would have been easily recovered and the great majority of them would have been doing useful work as the two surviving banks of Palhalli, Seringapatam Taluk and Hongenahalli, Malur Taluk, have been doing in spite of adverse circumstances. Various reasons have been assigned for the failure of the agricultural banks. The Committee think that the failure was due to inefficient management, lack of proper supervision and above all to the cheap capital that was available to them for borrowing. But I have already shown that there was no failure as regards non-coffee banks and in respect of the coffee banks the failure was due, I think, to the fact that the Government advanced money directly to these banks, the accepted principle being that the Government, if it furnishes any financial aid at all, should do so through an intermediate body who will supervise properly the application of the money and stand guarantee to it for its security. The department, I think, should try to revive the system and start new banks on that model with money borrowed from the Central Banks. There is absolutely no reason why a system which has succeeded so well in the barren tracts of Germany and has been successfully adopted by other countries should be a failure in our State.

The Government have been giving from time immemorial financial aid to the ryot in the shape of takkavi loans and now the system has received statutory recognition under Regulation No. IV of 1891 which is based upon the British Indian Act of 1884. It is now acknowledged that the measure is a failure inasmuch as it has failed to achieve the object in view, *viz.*, relief of the indebtedness of the ryot and so a demand is being made for the

establishment of separate land mortgage banks. Opinion is divided as to whether such banks should be on a co-operative basis or not. It has been frequently urged that an agricultural bank of the Egyptian type should be started. But the Egyptian bank is not considered to be an unqualified success. This is what a Professor of Economics in Egypt says about this bank :—

"The idea suggesting the foundation of the agricultural bank was of the happiest. . . . The peasantry have largely drawn upon its resources —now grown to twelve crores of rupees ; at the present time they stand at fifteen crores. To what uses has this enormous capital been put by them ? Only too often to one that was quite unproductive to pay the expense of some merry making, to buy some young fellow off his military service. Even where the loan has not been squandered in this fashion, it has often enough been wasted upon the purchase of land that did not pay the interest and sinking fund of the loan. During the last two years the bank has been able to recover its loans only partially and with great difficulty."

The Government of India had the system examined and they are of opinion that it is unsuited to India. HENRY WOLFF, the famous writer on Co-operation, says that "the tale of the Agricultural Bank of Egypt is manifestly, as an example for India, a tale of failure." He, of course, advocates a bank based upon co-operative credit system. An Indian writer on Economics observes as follows :—

"The importance of co-operative credit societies cannot be gain-said. They supply a badly felt want of the cultivator by providing him with credit where he has none. Agricultural operations are facilitated and higher profits are ensured. Credit societies very largely perform the same function as agricultural banks, and they are eminently useful to cultivators who have only small piece of land to mortgage. They enable them to capitalize their honesty and, on the principle of self-help and mutual aid, to improve their condition. This is an aspect of the agrarian and the general economic question which should not be lost sight of."

The Mysore Co-operative Committee have after full consideration recommended the formation of two State-aided Banks, one for arecanut growers and the other for coffee planters. There can be no objection to the Government granting financial aid to the proposed banks provided property security is forthcoming, but in the Malnad even the best property has no market value. Our experience of agricultural banks has shown that when the property is brought to sale, it fails to fetch an adequate price owing to the paucity of bidders. It will have to be purchased in the long run by the Government or allowed to remain in the possession of the defaulter himself with liberty to him to enjoy the produce without any liability for the payment of his debt.

COTTAGE INDUSTRIES.

There is another branch of the co-operative movement to which it is necessary to call the attention of the Co-operative Department as well as the Industrial Department, *viz.*, the neglect of cottage industry. It is stated in the report on co-operation that only one co-operative society of this kind is working in Bangalore. This is very disappointing after the enormous efforts made by the Government to resuscitate cottage industries. It is not

necessary for me to go into the history of those efforts, but as President of a Co-operative Conference, it appears to me that the Government's attempts failed because they were not based upon co-operative basis. The Department of Industries and the Co-operative Department should join hands and try to develop cottage industries. Societies for nakki-making, lace-making and for embroidery can be formed, raw material can be given to the workers and the finished products purchased. This will be a great boom to ghosha women and will go a long way to relieve their distress.

AUDIT AND SUPERVISION.

I have so far briefly dealt with the different types of co-operative societies that are now in existence in the State and shown the direction in which further development is possible. As regards audit and supervision, there is no suggestion anywhere that the departmental control and vigilance should be relaxed. It would be better if the central banks themselves take up the supervision of the primary societies and propagandist work. But in the present state of their finance I do not think they will be prepared to replace the department. Government have recently recognised the department and increased the number of Assistant Registrars. The suits filed by the Co-operative Societies are being disposed of with greater promptitude than before, but the progress in the execution of the decrees still continues to be slow. Government have issued instructions in the matter to their revenue officers, but a very heavy burden has been thrown upon the Revenue Department, there being as many as 3,899 decrees pending execution with them at the end of the year 1922-23. You have to consider whether it is not advisable to adopt the British Indian system of sending decrees for execution of Civil Courts, but if you decide that the present system should continue, you will have to consider whether it is not advisable to give a bonus to the Shekdar on decree amount recovered so as to serve as an inducement for prompt execution. Personally, I would prefer the employment of a Shekdar for a particular area, say, a Sub-Division, at the cost of the societies of that area. That will relieve him of the Government work and enable him to devote his full time and attention to the execution of co-operative decrees.

STATE AID TO CO-OPERATIVE SOCIETIES.

"State aid is said to be dangerous to co-operation" and that is the reason why the Government of India have abstained from giving financial aid to the societies except in the beginning of the movement. But the practice in European countries is different. "Some societies aided by the State in France have had a long and successful career." We in Mysore have followed the example of British India, but I think the depressed class societies will not be able to stand on their legs unless Government gives them financial aid in the beginning. Government will in time of emergency come to the aid of a central bank as the Goverment of India did during the time of the great war. But it is its present duty, I think, to arrange for a fluid reserve for the apex bank. The Central Co-operative Bank does not seem to require any such aid, but if its amalgamation with the Provincial Bank takes place as recommended by the Co-operative Committee, the question will assume importance and will perhaps be brought before the Government.

Satisfactory as the progress of the Co-operative movement has been in the State it has not yet added to national wealth or the prosperity of the

State as a whole, for the foreign money-lender and merchant are still flourishing in the State. In spite of the large number of agricultural credit societies established in the State, the Marwadi has been throwing his tentacles into the remotest parts of the State and the Labbe merchant is thriving as an exporter of grain. The foreign trade continues to be in the hands of outsiders and few Mysoreans have succeeded in establishing a foreign agency or depôt. Unless the Mysorean is more enterprising and prepared to take greater risks, he will remain in the background in the commercial world. We must look to the co-operative movement alone to produce men of this kind and when such men are forthcoming, the prosperity of the country is assured.

The rapid progress which the movement has made in the State is due entirely to the interest which HIS HIGHNESS THE MAHARAJA and HIS HIGHNESS THE YUVARAJA have taken in the movement. It becomes the members to work honestly and zealously to promote the welfare of the societies to which they belong. They should avoid the main defects of societies, *viz.*, irregularity and unpunctuality in payment and should not allow the affairs of the society to drift into the hands of the Secretary. Says PROFESSOR MARSHALL: "The true co-operator combines a keen business intellect with a spirit full of an earnest faith and some co-operative societies have been served excellently by men of great genius both mentally and morally—men who for the sake of the co-operative faith that is in them, have worked with great ability and energy and with perfect uprightness, being all the time content with lower pay than they could have got as business managers on their account or for private firms. Men of this stamp are more common among the officers of the co-operative societies than in other occupations and though they are not very common even there, yet it may be hoped that the diffusion of a better knowledge of true principles of co-operation and the increase of general education are every day fitting a large number of co-operators for the complex problems of business management." It is hoped that our co-operative societies will produce men of this type who will carry the movement to higher stages of development.

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EIGHT AIMS FOR THE CO-OPERATOR.

Co-operation is not a "get-rich-quick" method, nor a panacea for all the ills of the business side of farming. Co-operative combinations of farmers can be usefully formed to achieve the following objects :—

To obtain better value for produce
To improve the quality and appearance of produce
To cut out all unnecessary middlemen's profits
To break up rings
To cheapen purchases and insurance
To facilitate the obtaining of credit
To create markets and to steady them
To make possible the utilisation of the best machinery and sires.

AGRIC. GAZ. N. S. W., VOL. XXXIV PT. 6.

GENERAL.

THE DEVELOPMENT OF AGRICULTURE IN INDIA.

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Director of Agriculture, Central Provinces.

Agriculture is admittedly our largest industry in India and furnishes practically all the material for the food and clothing of the people as a whole as well as raw materials for the larger part of our manufacturing industries : over the greater part of India it is in a backward state at present and therefore offers great scope for development on scientific lines. The value of the land, buildings, stock, implements, etc., which form the capital of the land-holders of this country, must run into thousands of crores of rupees : the value of that could almost certainly be doubled by the application of science to practice. The scope for improvement is so great that the cost to Government of maintaining an efficient Department of Agriculture should be insignificant as compared with the value of the results which such a department would in course of time produce. Rapid progress will necessarily be slow owing to the apathy and ignorance of the people themselves. It is the bounden duty of Government therefore to provide the driving power ; in no other way can it be provided. In India an intelligent appreciation of the value of research and of scientific methods hardly exists outside Government departments ; very few of our public men who voice the sentiments of the people are personally interested in the development of agriculture, and our practical agriculturists are not sufficiently well educated to be able to express their views clearly, or to give a scientific department the backing it requires and deserves. India is placed at a disadvantage in this respect as compared with England, for example, with its large number of up-to-date "gentlemen" farmers, many of whom have studied the theory and practice of scientific agriculture at Universities and Agricultural Colleges. These farmers themselves conduct experiments with the assistance of the large staff of scientific advisers employed by the Ministry of Agriculture, the Universities and Colleges ; they keep in touch with every new development in agriculture by subscribing for scientific periodicals, and play an important part in moulding the policy of Government. Living as they do in a scientific atmosphere, they appreciate the value of science and give the scientist the backing he needs.

THE APPLICATION OF SCIENCE.

The standard of cultivation in India to-day closely resembles that which obtained in England two centuries ago, when the wooden plough, since relegated to the museums as a relic of the past, was the tillage implement in common use. Such land as was under cultivation in England at that time gave very poor yields, and for want of efficient implements and draught power very large areas were never cropped. The agricultural unit in

England at this time was the village with its scattered holdings, common grazing grounds, half starved cattle, and poor crops resulting from bad cultivation—all of which are characteristic of most parts of India at the present day. Wars and more especially the Napoleonic wars, the rapid development of manufacturing industries in urban centres, the consequent increase in the Urban population and the decrease in the population of rural areas all helped to force up wages and the cost of farm produce. High prices, coupled with a rise in the cost of labour, stimulated the use of labour-saving appliances and the production of larger acreage yields ; and the open field system of scattered holdings with its bad cultivation which resulted therefrom gave way slowly before economic pressure. In England the leading "gentlemen" farmers were the first to adopt the more intensive methods of farming demanded by the times. Holdings were consolidated and fenced, and the cultivation of turnips, clover and other new crops which were to revolutionize farming was taken up on a large scale. There was as yet no science of agriculture which could be applied to the solution of its manifold problems. Men like JETHRO TULL, BAKEWELL, LORD TOWNSEND and YOUNG, though not themselves scientists in our sense of the term, possessed the scientific habit of mind which they brought to bear on the agricultural problems of the day, and thus prepared the way for scientists who about the middle of the nineteenth century did so much for the development of English agriculture. As a result of the war of 1914-18 scientific enquiry in all branches of agriculture has been stimulated afresh in England. Statesmen and the public generally now realize the paramount importance of scientific investigation and of providing for the endowment of work connected with the development of agriculture on a scale commensurate with its great importance. They see, as they never did before, that the countries which have made the greatest progress and which obtain from the soil the highest return are those which have developed their research institutions.

AN ECONOMIC REVOLUTION.

The introduction of improved implements and machinery, of better seed and cattle and of manures and crop rotations which followed in the wake of scientific investigation revolutionized agriculture in the West, and has in about a century and a half enabled the English farmer to double the outturn of his crops, to drain and bring under cultivation large areas of waste land, to improve his methods of cultivation generally, and to make much larger profits. The increased productiveness of the land effected was all in the interests not only of the cultivator, but of the average citizen, helping as it did to keep down the cost of living at a time when our population was fast increasing. It was in the interests of the nation, too, in enabling it to hold its position in the markets of the world ; but for the development of agriculture it would have been impossible for England to feed the hundreds of thousands of urban workers employed in her factories, and she could never have developed her great manufacturing industries. If India desires to develop her main industry—agriculture—it can be done in the same way as it has been and still is being done in England and other advanced countries, namely, by employing highly qualified investigators to show the way, and by disseminating the results of their work among the cultivators.

History repeats itself ; the economic conditions which obtain in India to-day resemble in many respects those which led to the development of more intensive farming in England in the eighteenth century. The price of farm produce has risen very much : industries other than agriculture are drawing labourers from rural to manufacturing centres, and there has been a general rise in wages. If he is to take full advantage of the new situation thus created, the land-holder in this country will have to follow the example of the English farmer by adopting more intensive methods of cultivation involving the use of labour-saving machinery, of manures, and of better methods of cultivation generally. There are many indications that he is beginning to do so, the pity is that he is not as yet sufficiently well educated to take much part in moulding the policy of his Government. His supposed views are generally represented by men who live in towns and who are not practical agriculturists. This class of politician has within the last two years somewhat weakened the driving power of the Executive Government and progress is thereby being retarded.

The land-holder in this country, unlike the English farmer of a century and a half ago, is in the fortunate position of having at his back a body of agricultural scientists who have, by research and experiment, produced results which should be of the greatest value if applied. Much has already been done to improve the cattle and the staple crops of the country by selection and by hybridization, and the financial results therefrom have been most striking. To take but one example, namely cotton, the area now being sown in India every year with improved varieties probably exceeds 2,000,000 acres, and the increased profits therefrom, calculated on the basis of an increase of Rs. 10 per acre, must be somewhere in the neighbourhood of two crores of rupees annually. There is no reason, however, why the increased profit on the cultivation of this crop should not be raised to twenty-three crores of rupees a year; for the total area under cotton is over 23,000,000 acres. In one province alone, namely, the Central Provinces, the introduction of a selected cotton is reckoned to have increased the annual value of the cotton crop by at least 70 lakhs of rupees which covers the annual expenditure on the working of the Department of Agriculture seven times over. For the improvement of other important crops, such as rice, wheat, *juar* (*Sorghum vulgare*), oil seeds and jute, there is also great scope for improvement, and much has already been done in that direction. It is no exaggeration to say that the value of crops in this country could be increased by hundreds of crores, by merely substituting improved strains of seed for the inferior low-yielding varieties at present grown.

CATTLE BREEDING.

In India where the bullock is the draught animal in common use and where milk products are common articles in the dietary of the people, cattle-breeding is of enormous importance. Poor draught cattle result in bad cultivation ; bad cultivation results in poor outturns of grain for the cultivator and of fodder for his cattle ; this again results in an impoverished cultivator and in weak and therefore inefficient draught bullocks. How to break this vicious circle is one of the most difficult problems facing the scientific investigator and Indian farmer to-day ; for the standard of

cultivation possible is largely dependent on the quality of the draught bullocks available. The introduction of improved implements on a large scale would be practicable if there were bullocks sufficiently strong to work them. The position, however, is by no means hopeless. Cattle in India to-day are probably but little, if any, inferior to those which were found in England in the middle of the eighteenth century. By better breeding and feeding English breeds have since that time been improved out of all resemblance to their progenitors. The improved breeds evolved have gained a world-wide fame, and England has become the world's principal stud farm. In the middle of the eighteenth century we read that cows in England were such poor milkers that they did not produce enough milk to feed their calves, and that an average cow could be purchased for £3 or Rs. 45 in Indian money. By selection and cross-breeding, cows of some of our English breeds now yield 40 seers of milk daily and are worth at least Rs. 750. Most cows of Indian breeds are such poor milkers that it does not pay to keep them for dairy purposes; the average cow when in full milk seldom gives more than 6 lb. of milk per day. By selection and crossing the quality of breeds both for milk and draught purposes has, on Government farms, been greatly improved, and what is being done to-day on Government farms will be done in 20 years or less by enterprising cattle-owners in this country. A herd of Montgomery cows on the farm of the Pusa Research Institute has within 10 years been improved to such an extent by selection that their average daily milk yield per cow has increased from 5½ to 9 lb. per day, including dry periods during which no milk was given. This improvement should add at least 40 rupees to the value of each animal; but the improvement effected by cross-breeding is still more striking, the average yield from the Pusa Ayrshire-Montgomery crosses on the same basis of calculation being 15 lb. per day. The improvement effected on some of the breeding farms managed by Provincial Governments where draught breeds are kept is also worthy of note. The animals bred thereon are much larger and stronger than those reared in villages under existing conditions, and they are probably worth at least Rs. 40 more per head. Taking into account the fact that there are about 14½ crores of animals in India, it is evident that there is enormous scope for adding to their value by better breeding and feeding.

AGRICULTURAL IMPLEMENTS.

The Indian cultivator is working at a great disadvantage owing to the inefficiency of his agricultural appliances. His tillage implements are so light and small that they do not kill out weeds effectively; nor can they be used for ploughing under weeds and other forms of leaf manure when that is necessary. Of all the implements in common use in India the country plough or *nagar*, as it is commonly called, is perhaps the most inefficient. It may be described as a piece of wood shod with an iron point which constitutes the share. It is fitted with a wooden pole and is usually drawn by one pair of bullocks. Having no breast it stirs the soil without inverting it, and, having no cutting parts it does not eradicate weeds. The argument advanced against the introduction of iron ploughs and other improved implements is that they are generally heavier to pull than those in common use, and are not, therefore, suitable for the draught cattle of this country. The improved implements are, however, appreciably lighter in draught as a rule than those which they are replacing. The M. S. N. plough so popular in rice tracts weighs 34 lb. and can be drawn by a pair of very small bullocks.

Ploughs of the Rajah and Punjab types which have found favour in the Gangetic valley are not too heavy for one pair of ordinary bullocks.

In black cotton soil tracts, improved iron ploughs have become very popular ; thousands are now being sold there every year and some cultivators have of late years taken to the system of ploughing land on hire with Turnwrest ploughs after completing their work on their own farms. Another plough, which has done exceptionally well in this tract, is the Sabul which is specially suitable for ploughing cotton land in the dry season. An important feature of the Sabul plough is that it is equipped with a share having a renewable and adjustable bar point made from a specially prepared high carbon steel. The plough weighs 145 lb. and does better work when drawn by two pairs of bullocks than the heavy *desi* plough which requires three pairs.

Land-holders are beginning to realize that it pays to eradicate from their fields perennial weeds such as *dub* (*Cynodon dactylon*) and *kunda* (*Andropogon punctatum*) which in badly tilled fields compete year after year with their staple crops for the limited amount of moisture and plant food available in the soil. The loss in yield due to the growth of weeds in cultivated fields must in the aggregate be colossal, more especially in tracts where *kharif* crops are mainly grown. But even in *rabi* tracts, where wheat and gram are the principal staples, the loss in yield every year due to the low standard of cultivation and to the perennial crop of weeds resulting therefrom is enormous. *Kans* grass (*Saccharum spontaneum*), one of the most obnoxious of these weeds, has got thoroughly established over large areas in Central India, the Central Provinces and Bundelkhand in the United Provinces. This weed has a stoloniferous root which branches freely at a depth of about 7 or 8 inches from the surface. It is found in the best wheat soils which retain moisture in the hot weather and many hundreds of thousands of acres of such land have gone out of cultivation in consequence. Much of this area has lain fallow since the famines of 1896 and 1900; but in addition to this fallow area, there are many hundreds of thousands of acres in which *kans* competes year after year with the wheat, gram and other *rabi* crops grown, the yields of which are thereby greatly reduced. After each famine the draught power of the village is reduced, for many bullocks die of partial starvation and the strength of the remainder is reduced owing to the same cause. For want of sufficient bullock power the weed gets the upper hand and the land is allowed to lie fallow thereafter. Such is the fate of the patient plodding tiller of the soil in India to-day where the bullock supplies the motive power. In a famine year unfortunately the quantity of food required by the bullock to produce the energy needed is not forthcoming. The Settlement Officer of Saugor District in the north of the Central Provinces says that the area under *kans* in that district alone amounted in 1916 to about 180,000 acres or 15 per cent. of the cropped area. We may take it that land-holders in *kans*-infested tracts are losing at least Rs. 30 an acre annually by allowing any such land to lie fallow.

TACKLING THE WEEDS.

To reclaim *kans* land by means of the ordinary implements used in the villages is almost impossible, except when the weed is tackled in its

early stages by more or less continuous ploughing, and even then it is extremely difficult to accomplish. Small areas of *kans* have been eradicated by means of both the Sabul and the Turnwrest ploughs worked to a depth of 7 or 8 inches. With the inferior bullocks available in the wheat tract it is difficult, however, for the ordinary cultivator to use these ploughs in the dry weather when the soil is dry and hard; and *kans* cannot be killed by ploughing during the rains. The introduction of the motor tractor may perhaps solve the difficulty. The cost per acre of ploughing clean land with tractors is about Rs. 20, including interest and depreciation :- in stiff soil badly infested with *kans* the indications are that the cost will be about Rs. 30. But even at Rs. 30 it will pay the owner very handsomely to have such land brought under cultivation, seeing that one crop should about cover the cost of reclamation. When tractors are used, the land can be ploughed in the dry weather in which case the roots of the weed are killed by being exposed to the sun and dry air.

From experiments already carried out it would appear that over 90 per cent. of the roots are killed by one ploughing. Enterprising land-holders at times eradicate small areas of *kans* by manual labour, in which case the cost of hand-digging amounts to Rs. 80 an acre. In a test carried out on the College Farm, Nagpur, it was found that when employed for eradicating *kans* a tractor did as much work per day as 16 pairs of bullocks, and as much as 288 men when employed in removing the roots by digging.

On the strength of information obtained from these and other experiments, the Government of Central Provinces has agreed to give loans under the Land Improvement Loans Act to cultivators desirous of eradicating *kans* and other perennial weeds from their fields, and the Department of Agriculture is now working tractors lent by an enterprising Bombay firm ploughing weedy land for cultivators at a fixed acreage rate. Syndicates or private firms will, it is hoped, take up this important line of work in course of time. It requires no great strength of imagination to understand the potential value of mechanical power if used for converting such fallow areas into productive land.

USE OF TRACTORS.

There is a good deal of controversy as to the respective merits of steam cable sets and motor tractors. Into this controversy I do not wish to enter; suffice it to say that the former would probably prove the more efficient for work in the *kans*-infested areas already referred to. Their initial cost is, on the other hand, so high that there is little chance of their being tested by Government in these days of financial stringency. The tractor is being tried because it is much less costly: it can, moreover, be used with advantage not only for ploughing and cultivating land, but for driving stationary machines such as cotton gins, pumps, flour mills and fodder cutters. As at present designed, the tractors tried are not sufficiently strong and fool-proof for Indian conditions, and much difficulty has been experienced in some provinces in keeping them in good running order. Workshops where repairs can be executed are few and very far between, and all the agents in this country have not yet realized the paramount importance of keeping a large supply of spares in stock. Still the fact remains that under specific conditions and with intelligent use the tractor is a farm-power unit of great

possibilities in tracts where the draught power at present available is inadequate. There are on the market at the present time more than 50 makes of tractors varying to some extent in type. They may be roughly classified as wheeled types and caterpillar types.

Tractors of the caterpillar type are well suited for after-cultivation work; their weight is distributed over a much larger area than that of wheeled tractors, and they do not therefore pack the soil so much. They can for the same reason be worked on land which is too wet for wheeled tractors. Another advantage claimed for this type is that they are very suitable for work in small fields as they can be turned in a small space. For ploughing hard land there is little to choose between the two types; but it may be claimed for the wheeled types that there are no tracks to be renewed every second year or so, and that the cost of upkeep is, therefore less. For stationary work both kinds are equally suitable. Both types suffer in the hands of careless drivers from over-heating and many breakdowns are due to this cause alone; for it is extremely difficult at present to get in this country properly trained mechanics, and to put a tractor in the hands of a man of the cooly class, even after he has been trained to drive it, is to court disaster. This and other difficulties will, however, gradually disappear with the advent of facilities for training mechanics.

The improvement of draught cattle, the introduction of better implements and the use of mechanical power will enable the cultivator to perform his tillage operation under optimum conditions ; poor yields are often due in no small measure to the land being ploughed badly or too late. The wheat grower, for example, who harvests his crop in March spends weeks in treading out the grain under the feet of his bullocks and in separating it from the chaff. Given a good threshing machine and winnower, this work could be done in as many days. So much time is spent over each operation at present that ploughing for the next crop has often to be put off till the rains. Over a greater part of the wheat tract, the monsoon breaks about the middle of June, and in years of heavy and continuous rainfall the breaks are so short that the area ploughed before the close of the monsoon is small. With the abrupt cessation of the monsoon, the soil rapidly dries and becomes too hard for ploughing with the country plough. The seed has thus to be sown in a badly prepared seed-bed. Ploughing with improved ploughs in the hot weather has, in some parts of India, increased the yield very largely. Land ploughed before the rains break absorbs much more of the rainfall than unploughed land. Ploughing provides for the better aeration of the soil, too, and thereby stimulates bacterial action in the formation of nitrates. Ploughing thus done under optimum conditions provides for the succeeding *rabi* crop a store of moisture and nitrogen.

DEMAND FOR IMPROVED IMPLEMENTS.

The introduction of improved tillage implements has opened up a vista of great possibilities for the agriculture of this country The efficiency of these implements is largely due to their having been designed by the trained engineers of certain firms working in collaboration with agricultural experts in India. Many of the improved ploughs thus introduced have met a felt want. Machines for harvesting crops, for cleaning grain and for chopping fodder have yet to be evolved. A reaping machine suited for

cutting *juar* would be a boon ; such a reaper should be high-geared and should have a short cut of from three to four feet. The fingers of the knife bar and the knife itself should be strong and the sheaf board long enough to support the stalks which are usually six or seven feet long and about three-quarters of an inch in diameter. For wheat mowers there is already a small demand which is likely to increase, as the cost of labour, more especially at harvest time, is rising.

For fodder cutters a fair demand already exists. In *juar*-growing tracts about one fifth of the stalk is wasted when fed whole to cattle, as they refuse to eat the coarse ends unless they are cut into small pieces. The high price of these machines prevents all but well-to-do cultivators from buying them.

For winnowers, too, a demand already exists ; but the prices charged for imported machines are so high that cultivators cannot afford to purchase them. The winnowers made in India by village carpenters are less expensive, but at the same time less durable. The sale of these inferior country-made imitations of imported machines is no doubt detrimental to the trade in agricultural machinery generally ; but the solution of the difficulty is in the hands of the big manufacturer. To create a demand, they must be prepared to supply India with her requirements at reasonable prices.

The method in vogue in India of treading out the corn with the muzzled ox is a slow and primitive process. The need of improved machinery is becoming more evident every year. Threshers driven by oil engines are now being used on Government farms and will no doubt find favour among cultivators in course of time. One objection to their use is that they do not break up the straw into small pieces. This objection, however, is not a very serious one, perhaps, seeing that this can be done later by means of a separate fodder cutter.

The demand for improved iron cane mills of the three-roller type and capable of being worked by a pair of bullocks is very great. Most of these bullock-driven mills give about 10 per cent. more juice than the *desi* mill which they are fast replacing. Their introduction must be adding lakhs of rupees every year to the profits of cane cultivation in India; for there are now hundreds of thousands of them in use. It is a pity that no firm in England has specialized in the manufacture of bullock-driven cane mills; for the workmanship of those turned out in India is generally poor. The mills turned out by the Nahan foundry in the Punjab are an exception to the rule, and the demand for the mills made there exceeds the supply. A small all-iron cane mill capable of crushing half a ton of cane per day when worked by a pair of bullocks would find a ready market in this country if offered for sale at Rs. 200 or less.

FENCING AGAINST ANIMALS.

Wild and domesticated animals do a great deal of damage to crops in India. Wire fencing is used on a small scale only, and the result is that stray cattle in the villages as well as antelope, wild pigs, jackals, etc., rob the cultivator of the fruits of his labour. Of the wild animals to be considered in this case, the wild pig is perhaps the most destructive. Being a nocturnal feeder he lies hidden during the day in the jungle or grass-covered wastes which are often many miles from the crops, on which he feeds. The

cultivator sometimes constructs a fence of thorns or bamboos round the field he wishes to protect, but as all such fences are more or less inefficient, it is customary for him to keep also a watcher in the fenced fields at night. The wild yells of this watcher on the approach of "grunters" are generally sufficient to scare them away; but, at times, Homer-like he nods and the pigs break in and steal. In the morning the owner of the field finds that his crop has been very materially damaged and his profits for the year thereby reduced. Patent pig-proof woven wire fencing has been introduced in some provinces with good results. The demand for this type of fencing wire is likely to increase very largely.

The whole field of Indian agriculture still bristles with unsolved problems; but in a short article it is possible to deal only with a few of the outstanding ones. The activities of Provincial Departments of Agriculture extend over a wide field and improvements are being introduced which are both adding to the wealth of the cultivator and fitting him for further progress. The great task of reconstruction is well worth all the brains and energy which can be put into it; for on the development of agriculture depends not only the prosperity of India's many millions of agriculturists, but to a great extent the lot of those engaged in other industries, too. Increased crop production will help to banish famine and poverty from the land and to bring us nearer the realization of our desire, namely, to make India "a garden ringing with cheerful and contented life, with smiling fields and food in plenty."—AGRIC. JOURN. OF INDIA. VOL. XIX., PT. II.

SWEET POTATO.

W. MOLEGODE, AGRICULTURAL INSTRUCTOR.

The Sweet Potato (*Ipomœa batatas*) is an important food crop in Ceylon. It is grown throughout the Colony chiefly in the Central, Southern, Western and North-Western Provinces. Its cultivation has, within the last few years, spread very appreciably. It is a popular food, easily raised, giving large yields and selling readily. It has no equal from the point of a cheap and nutritious food and as a substitute for the regular diet of the people in the event of a rice famine. In some Tropical countries such as the Pacific Islands, Tropical America it is the principal food of the people. It is grown extensively in Japan and in that country something like 700,000 acres are cultivated with this crop. In the United States of America nearly a million acres are devoted to sweet potato. In the Southern States specially it is very extensively grown and is recognised as one of the principal vegetable foods of the inhabitants.

VARIETIES.

There are a large number of varieties of sweet potato, differing in shape, colour, and bearing habit. Some produce extremely large tubers weighing 10 to 12 lb. each, others perfectly round ones of a moderate size. Some produce in clusters around the main roots, others spread widely. In some varieties both the vines and tubers are purplish or reddish. In others the leaves are green and tubers red. In most varieties, however, the tubers

are brown, whitish or yellow. All varieties come under two main heads—the early and late varieties. The former reaches maturity in three to four months and the latter takes five, six and some seven months. A few years back ten varieties of improved types of the 'age' of six and seven months were introduced to the Colony and these are fairly extensively grown now.

The folloing are among the varieties introduced in recent years :—Cluster, Jersey, Red Jersey, Pumpkin Yams, Black Spanish, Southern Queen, Shanghai, Scaly, Joes, Raison, and Pierson. The Jersey group which has multiplied into many kinds are becoming very popular. At Peradeniya the 'Jersey' which is described as "growth healthy and vigorous, leaf crinkled, tubers medium uniform, clustered close to the stem and easy to dig, skin smooth light yellow" gave a yield of 12,972 lb. per acre. The cluster sweet potato which was originally introduced from Queensland is rapidly replacing the native varieties.

CULTIVATION.

Soil and Climate.—The best soil for sweet potato is a light well drained sandy loam. Stiff clayey and wet soils are unsuitable. On very fertile soil the crop tends to run into vines at the expense of the tubers. In Ceylon this crop is grown from sea level up to about 4,500 feet elevation. The ideal conditions are moderate rainfall during early growing period and lot of sun.

Culture.—Propagation is usually by cuttings of the matured stem. If cuttings are not available few well formed tubers of a medium size put in nursery will send up shoots from which cuttings could be obtained to establish a plantation. The soil for sweet potato should be worked to a depth of 6 or 8 inches. The best method to plant is on ridges. These should be raised about 6 inches, and should be about 3 feet from centre to centre with a shallow trench between. The cuttings should be planted about 12 inches apart. These should be about 9 inches long and buried about 3 inches deep in the soil and the soil firmed around each cutting. The soil should be moist at time of planting. If it is dry weather it will be necessary to water for a few days. The cuttings will strike root in about a week and after that the growth will be vigorous. The long trailing branches should not be allowed to root at the nodes. They should from time to time be turned back towards the centre of the ridge so as to secure a better yield of good tubers from the main root.

Manuring.—Sweet potato exhausts the soil to a great extent. When it is intended to continually grow this crop a good application of manure is necessary. What manure and quantity to be applied depends on the soil. An excessive amount of organic matter in the soil will frequently produce more leaf and stem at the expense of the tubers, at the same time it is possible that the tubers will be small and the yield poor on soils that do not contain sufficient organic matter to produce a fine growth of vine. The best results have been obtained from lands heavily manured for the previous crop. A leguminous crop grown in rotation and the green stuff ploughed in will give sufficient organic manure. A liberal application of lime should be made at the time of ploughing in. A good application of rotted stable manure when possible, several tons per acre, will be found very beneficial on worn-out land deficient in organic matter, but the application

must be made at the time of preparing the soil. Quite the best and most economical way of maintaining the suitability of land for sweet potato is by adopting a rotation of crops. Cowpeas (*Vigna catiang*), Green gram (*Phaseolus mungo*), Horse gram (*Dolichos biflorum*) and Black gram (*Phaseolus radiatus* could be grown in rotation with sweet potato. The crop responds well to commercial fertilisers containing 2 to 4% nitrogen, 6 to 8% phosphoric acid and 8 to 10% potash. This has been recommended as a good all-round mixture but the amount of each ingredient will however depend on the nature of the soil and may be increased or reduced.

Fertilisers should be applied at the right time—a week or ten days before planting. If applied just before planting they may injure the cuttings.

Lime has a beneficial effect on sweet potato hastening maturity and increasing the yield, and specially when a green manure crop is ploughed in a good application of lime will do good.

HARVEST AND YIELD.

The crop is ready for lifting when the leaves begin to turn yellow, which will be from about the hundredth day of planting for the early variety and from about fifty days more for the later varieties. To ascertain the proper maturity of the tubers, dig out a few tubers and cut them through. If the sap dries soon and forms a white crust over the surface the tubers have reached maturity. Before digging for the crop cut off all the vines. Care should be taken not to injure the tubers as injured ones will not keep well. Sweet-potato sometimes is allowed to remain in the soil for some months, lifting only as required.

The yield depends on the soil and other conditions and the variety grown and cultural methods adopted. Yields vary from 8 to 15,000 lbs. per acre. Under perfect conditions yields of over 25,000 lb. have been obtained in the Philippine Islands. At Peradeniya the Jersey variety has given 12,975 lbs.

USES.

The uses of sweet potato as a vegetable food are well known. In some localities sweet potato is dried for its flour. The leaves are also used as a vegetable. The vines are used as fodder. In Japan it is an important fodder crop. The following analysis of the sweet potato and the potato will show the comparative food value :

	Sweet Potato	The Potato.
Water	70·36%	76·22%
Proteid	2·04%	2·21%
Fat	·87%	·13%
Carbohydrates ...	24·31%	19·94%
Fibre	1·33%	·34%
Ash	1·09%	1·29%

STORING.

Sweet potato can be kept for a long time if properly stored. In the Southern States of America where the industry is a very big one, storage houses are specially constructed. To keep sweet potato for any length of time it is necessary that the crop should be carefully handled. The tubers must not be injured, they should be free of adhering earth, free of surface moisture and must not be exposed too long to the sun. The following simple method of storing is recommended. Put a thick layer of dry sand; on this place a layer of sweet potato, run in sand until all crevices are filled up and the tubers are covered, place another layer of sweet potato and repeat the process till the lot is stored; cover the whole with straw or any such dry material.

MARKET RATES.

MARKET RATES FOR SOME CEYLON PRODUCTS.

(FROM THE CEYLON CHAMBER OF COMMERCE WEEKLY PRICE CURRENT, DATED 7th APRIL, 1924.)

NAME OF PRODUCE		CURRENT PRICE Rs. cts.	at	Rs. cts.	REMARKS
CARDAMOMS					
All round parcel well bleached	per lb.	3 70	,,	3 90	
Do do medium	do	3 30	,,	3 60	
Special assortment O & I only	do	4 00	,,	4 35	
Seeds	do	3 65	,,	3 80	
Green	do	2 60	,,	3 00	
CINNAMON QUILLS—[At Buyer's Stores]					
Ordinary assortment (in bales of 100 lb. nett)	per lb.	0 59	,,	0 67	
No. 1	do	0 62	,,	0 66	
No 2	do	0 59	,,	0 64	
No. 3	do	0 55	,,	0 62	
No. 4	do	0 53	,,	0 59	
CINNAMON CHIPS—Maradana, (At Buyer's Stores in bags of 56 lb. nett) per candy of 560 lb.		55 00	,,	65 00	
CITRONELLA OIL—(ex-Seller's Stores without packages) ...	per lb.	2 10		2 20	
CACAO—(At Buyer's Stores)					
Estate—Finest	per cwt.	54 00	,,	58 00	
Do Medium	do	40 00	,,	53 00	
Do Common (Black)	do	15 00	,,	30 00	
COCONUT—(Desiccated) Granulated goods (Delivered at Wharf or Buyer's Stores)					
Assortment: Medium 50 per cent. Fine 50 per cent. ...	per lb.	0 21¾	,,	0 23	
COCONUT OIL—					
White Oil f.o.b	per ton	610 00	,,	620 00	
Ordinary Oil do	do	567 50	,,	575 00	
COPRA—					
Calpentyn, Estate, Ordinary quality (Maravila), Cart Do do — *No. 1 quality per candy of 560 lb.		85 50	,,	87 25	
FIBRES—(At Buyer's Stores)					
Coconut Bristle No. 1	per cwt.	13 00	,,	14 25	
Do No. 2	do				
Coconut Mattress No. 1	do	2 65	,,	3 20	
Do No. 2	do				
Coir yarn Kogalla Nos. 4 to 9	do	12 00	,,	25 00	
Do Colombo Nos. 3 to 7	do	12 00	,,	25 00	

PLUMBAGO		X. B. Rs. cts.		Rs. cts.	B Rs. cts.		Rs. cts.	B. E. Rs. cts.		Rs. cts
Ordinary Lumps	per ton	300 00	at	350 00	215 00	at	250 00	150 00	at	185 00
Chips	do	175 00	,,	250 00	150 00	,,	200 00	100 00	,,	150 00
Dust	do	100 00	,,	175 00	70 00	,,	125 00	40 00	,,	75 00
Do Flying	do	60 00	,,	145 00	40 00	,,	95 00	25 00	,,	60 00

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 30th APRIL, 1924.

Province, &c.	Disease	No. of Cases up to date since Jan 1st, 1924	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	303	83	88	197	11	7
	Foot-and-mouth disease	3	—	3	—	—	—
	Anthrax	—	—	—	—	—	—
Colombo Municipality	Rinderpest	236	Figures	for	April	not to	hand
	Foot-and mouth disease	—					
	Anthrax	—					
	Rabies	—					
Cattle Quarantine Station	Rinderpest	3	Figures	for	April	not to	hand
	Foot-and-mouth disease	8					
	Anthrax	75*					
	Pleuro-Pneumonia (in goats)			—	48†		
	* 2 cases amongst cattle						
Central	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	34	34	23	1	10	—
	Anthrax	3	—	—	3	—	—
	Piroplasmosis	4	—	3	—	1	—
Southern	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	2	—	2	—	—	—
	Anthrax	—	—	—	—	—	—
Northern	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	—	—	—	—	—	—
	Anthrax	—	—	—	—	—	—
	Hæmorrhagic Septicæmia	98*	1	3	95	—	—
	* 23 cases amongst goats						
Eastern	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	1	—	1	—	—	—
	Anthrax	—	—	—	—	—	—
North-Western	Rinderpest	243	—	92	146	—	5
	Foot-and-mouth disease	67	42	67	—	—	—
	Anthrax	—	—	—	—	—	—
	Rabies	1	—	—	—	—	1
North-Central	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	78	—	78	—	—	—
	Anthrax	—	—	—	—	—	—
Uva (reported Black Quarter)	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	—	—	—	—	—	—
	Anthrax	3	—	—	3	—	—
	Hæmorrhagic Septicæmia	11	11	—	11	—	—
	or Black Quarter	Under	Investigation				
Sabaragamuwa	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	76	—	76	—	—	—
	Anthrax	6	—	—	6	—	—
	Hæmorrhagic Septicæmia	3	—	—	3	—	—
	Rabies	1	—	—	1	—	—

† 48 amongst 97 goats imported by Mr. C. E. A. Dias on 5th March, 1924.

M. CRAWFORD,
for Government Veterinary Surgeon.

Colombo, 7th May, 1924.

METEOROLOGICAL

APRIL, 1924.

Station	Temperature: Mean Daily Shade	Temperature: Difference from Average	Mean Humidity	Mean amount of Cloud 0=clear 10=overcast	Mean Wind Direction during Month	Daily Mean Velocity	Rainfall: Amount	Rainfall: No. of Rainy Days	Rainfall: Difference from Average
	°	°	%			Miles.	Inches		Inches
Colombo Observatory	82·6	0	82	6·2	SW	96	8·92	20	+1·14
Puttalam	83·2	+0·4	81	3·0	SW	140	1·90	8	- 3·59
Mannar	85·7	+0·4	75	4·8	SW	161	2·90	5	+0·10
Jaffna	86·5	+0·7	71	3·0	SSW	235	0·25	4	- 1·72
Trincomalee	85·2	0	76	3·8	SE	130	2·40	3	+0·43
Batticaloa	84·0	+0·8	76	3·4	ESE	113	1·20	3	- 0·69
Hambantota	82·4	+0·6	82	3·9	SW	228	1·47	9	- 1·85
Galle	82·0	+0·2	84	5·4	SW	133	9·63	17	- 0·21
Ratnapura	83·5	+1·1	76	5·8	—	—	10·90	15	- 1·55
Anu'pura	84·1	+0·5	78	4·8	—	—	5·69	13	- 0·94
Kurunegala	83·5	+0·1	76	6·4	—	—	8·43	13	- 0·96
Kandy	79·8	+0·9	78	4·3	—	—	1·17	10	- 5·61
Badulla	75·6	+0·2	82	6·1	—	—	3·97	11	- 3·49
Diyatalawa	69·6	+0·2	77	6·6	—	—	3·43	14	- 2·18
Hakgala	62·2	0	86	6·5	—	—	2·63	14	- 4·18
N.' Eliya	61·2	+0·8	82	6·2	—	—	2·66	13	- 3·00

The weather of April as a hot weather month was typical of the period between the monsoons. In general, the mornings were fine and clear. Clouding became heavier as the day wore on and the clouds dissipated during the night.

Thunderstorms accounted for the precipitation, which occurred mostly in the afternoon or night.

The temperature has been higher than usual, and for the South-West of the Island and for the Hills has been very humid and trying.

Rainfall was heaviest in the South-West of the Island and at medium elevations. It was, generally, under the average. An excess of rainfall was experienced along the coast strip from Colombo southwards to Kalutara, centrally over the Northern Province, and in a few other places. The distribution in days on which rain was experienced followed very closely the actual distribution of rain.

Air pressure was below normal. From the 2nd a slight South-West gradient has existed which is perhaps responsible for the rainfall being heavier in the South-West quarter of the Island.

In consequence, the wind has been mostly from the South-West and, in general, slightly above average strength.

The following daily rainfalls of 5 inches or over were recorded during the month :—

17-18	Batapola,	5·90 inches
17-18	Hirimbura,	9·80 inches
17-18	Kalutara,	5·50 inches
19-20	Anningkanda,	6·03 inches
28-29	Oonoogaloya,	5·44 inches

J. E. EVANS,
Supdt., Observatory.